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ENVIRONMENT VIEWS

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Weather and Climate: Part Two

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ENVIRONMENT VIEWS

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Environment Views is published bi-monthly by Alberta Environment. Each issue deals with a specific topic from various viewpoints with the aim of increasing awareness of environmental issues among Albertans. *Environment Views* is directed by an independent board with representation from environmental groups, government and industry. The views expressed by the publication are not necessarily those of Alberta Environment.

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Letters to the editor are welcomed, and should be sent to The Editor,
Environment Views
Alberta Environment,
Communications Branch
11th Floor, Oxbridge Place,
9820 - 106 Street,
Edmonton, Alberta T5K 2J6

Editor:
Maryhelen Vicars
Researcher:
Susan Bramm

Editorial Board:
Jacquie Champion, Carey Johannesson, Jerry Lack, Jim Martin, Ray Rasmussen, Stephen Tyler.

The editorial board was helped in planning this issue by Will Prusak, Rod Olson and Bruce Thompson of the Atmospheric Environment Service, Environment Canada and Bill Kuhnke, chairman of the Alberta Climatological Association.

Cover photo: *Glenbow Alberta Institute*
A 1930s dust storm in the Lethbridge area.

Alberta
ENVIRONMENT

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Introduction :Maryhelen Vicars

The Human Side of Weather and Climate

They said there'd be a climatic change, but this is a bit ridiculous!
SUN TAN OIL
TUKTONUVIK POP. 409

Martha Jones

It takes a multi-million dollar hailstorm in Calgary or a flash flood that washes out roads in Edmonton for the weather to make the front pages of our newspapers.

The headlines are smaller, but the weather is also in the news if week after week of dry spring weather threatens the wheat crop, or if wet weather in the fall halts the harvest. This past winter, above-freezing temperatures in December and January were news — good for those who hate to shovel snow; bad news for skiers.

This issue of Environment Views looks at the human side of weather amd climate; the social and economic consequences of the phenomena we examined in the last issue.

While the drama of flash floods and record temperatures catches the public's attention, the costs and benefits of day-to-day weather conditions are less newsworthy but of no less importance to our lives and balance sheets. There is a human cost which can be tallied at several levels when the growing season is cold and wet, perhaps as a result of volcanic activity somewhere on the globe, or if expected rains don't fall.

In North America, the diversified economy can withstand a year or two of bad crops, although there will be individual hardships and some losses in secondary industries such as farm equipment manufacturing. But among the economies of the developing world, which are often dependent on the success of a single crop or industry, the results can be devastating.

Although the industrialized world is somewhat less vulnerable to the vagaries of climate, it will be a long time before we forget the Dirty Thirties, when the apparently boundless prosperity of the New World came to a dusty if temporary halt.

In this province, we are particularly aware of the weather. The fortunes of one of our largest industries, agriculture, are closely tied to the weather, although recent innovations may have improved the odds.

Some success has been reported in hail suppression and rainmaking by means of cloud seeding; crop varieties have been developed which mature earlier and are resistant to drought and pests.

The forest industry is similarly tied to climate, with the number of frost-free days and the availability of moisture limiting productivity. But in recent years, forest fires have posed a greater threat to the industry. As Paul Tisdall reports, (page 24) a spinoff from the American space program may hold the key to checking this destruction. By using sophisticated detection equipment, foresters hope to be able to pinpoint lightning strikes (a major cause of forest fires) in time to extinguish fires before they can cause widespread damage.

While these developments in agriculture and forestry are important, many climatologists feel we ought to be concentrating our energies on global solutions to the threat from climatic change.

For example, farming practices have improved greatly since the drought years of the 1930s and farmers can now cope with dry conditions better than they could then, but what would happen if the bad weather lasted; what if there were a permanent shift in our climate?

That is more than a hypothetical question, as Sharon Adams discusses in her story on man's impact on weather and climate (page 6). The pollution of the atmosphere and the clearing of watersheds are creating a gradual warming of the earth, according to most scientists. The result could be the flooding of coastal areas and the creation of deserts in already-arid regions — including southern Alberta.

Slowing or halting the warming trend will not be accomplished easily, if it can be accomplished at all. There is enormous pressure to continue the clearing of forests for agricultural land to feed a hungry world.

And despite some progress in energy conservation, there is little hope, either, of reversing the trend to greater and greater carbon dioxide emissions.

Maryhelen Vicars, a former journalist, is the freelance editor of *Environment Views*.

Letters

Dear Editor:

I am writing this letter in response to your September/October '82 issue which dealt with the issue of public land use. I myself am one of the land users in question — a "four-wheeler".

For as long as any of us can probably remember, there has been a continual "feud" going on between the various land user groups in Alberta. Four-wheelers, hikers, campers, snowmobilers, fish and game enthusiasts, hunters, bikers, the Alberta Wilderness Society, and environmentalists have each always felt that it is "the other guy" who is responsible for the environmental damage which has occurred in various wilderness areas. But when you stop to think about it, what is the one thing that all of these groups has in common? The end goal of each group is to be able to enjoy the natural, untainted beauty and peacefulness of the outdoors and wilderness. But, each group in turn needs a scapegoat on which to heap all the blame for everything. It's come down to a never-ending game of "US" and "THEM". As organized four-wheelers, we constantly feel the pressure, and so do all of the other user groups.

There is one other characteristic, though, which all of these groups share — they all use 4WD vehicles in one way or another. Every single last one. Fish and game groups use them to gain access to their favourite hunting and fishing grounds. Bikers and snowmobilers use them to haul their machines into their favourite areas. Environmentalists and wilderness people use them to study and enjoy nature. Hikers and campers make use of them as a means of access as well. And as organized four-wheelers, we do all of the above. So, what is all the fuss by all of these other groups about 4WD vehicles?

With the inception of Kananaskis Country, hearings were held in 1976, four years after the plan was set, so that the various user groups could have their say as to how the area could best be set up for efficient multi-use. Each group had its hearings held separately, and nowhere along the way was there a collaboration of ideas presented to the government. Kananaskis became a reality, and all user groups suffered. Four-wheelers, bikers, and snowmobilers were banned from the area all together. Hunters and fishermen, hikers, campers, wildlife people, and environmentalists can no longer use 4WD to get into their favourite areas. The roads which have been developed in Kananaskis have made certain areas so accessible by car as to cause them to become so congested that a great many hikers and campers, etc. don't use these areas any more. And the restriction of vehicular traffic throughout the rest of the area has made it totally inaccessible to them as an alternative. Hunters have left the areas as it isn't feasible for them to pack out their kill for long distances on foot back to the road. A lot of killed game has been left in the bush in Kananaskis for this reason. Much of the game which can be shot within easy packing distance of the road is no good anyway, as many of these animals are fed by ignorant motorists, become dependent upon this particular source of food, and eventually become unhealthy as a result. So what has been gained by all of this?

Kananaskis was planned and initiated by a group of government bureaucrats — a group of uninformed "non-users". Consequently, due to the lack of access to Kananaskis, extreme user pressure has been put to bear on other areas such as Maclean Creek, to the point that they have been totally destroyed by over-use. The government then sits back and tells us that such areas are a prime example of what happens when multi-use is allowed. But, it doesn't take much sense to see that what the government has done with Maclean Creek, and other areas like it, is the same as trying to contain a herd of buffalo in a china shop instead of letting them roam free. This sort of over-use wouldn't exist if land use was allowed to spread out naturally — but with reasonable restrictions.

If all of the user groups had been allowed to come together and form a single voice, pressure could then possibly been put to bear on the government to set up Kananaskis in a way which best suited us all. Insofar as road development went, that would have meant leaving it pretty much as it was originally. But keeping us at each others throats was their strongest weapon against us. "US" and "THEM" again. That is why each group's hearings were held separately from the others' — so that to any one group, all the others would look like the bad guys. In this way, a common understanding could never be reached, and the government was able to go ahead and do as it pleased.

We did eventually, however, see through their guise, and in 1979 attempted to set up the same sort of organization which exists in B.C. — a public land users' board. Through this board, all land users have been able to organize themselves into one united voice, and are able to let the B.C. government know how they want the land use designated in the best interest of all concerned. The B.C. government feels that this is the best system possible, and even offered to help us set it up here. Our group, thus armed, approached the Alberta government with this proposal, to which they listened politely, and said . . . "Thank you, goodbye, don't call us, we'll call you." They've never called.

Their weapon against a united voice for all land users in Alberta is still fully armed, and it's up to us to disarm it. If you were to put members of each and every user group into one room, eventually you would find that we are all basically the same; we all want the same things, and we're all environmentally conscientious, ie., we are all environmentalists in the biggest sense of the word. So, let's stop pointing our fingers at "THEM", and become united as "US". It's our only hope to being able to use OUR lands to the best advantage of all concerned.

Yours sincerely
Mike Yakey
4-Wheel Mountain Cat Club
Calgary, Alberta

Letters

Dear Editor:

In the November/December 1982 issue of Environment Views, the article on page 3, first paragraph states that "Alberta, with only 10 per cent of Canada's population, produces 20 per cent of the country's agricultural products: 50 per cent of the barley; 40 per cent of the canola . . ." Could you tell me what other name might be used for canola or what canola is? Thanks for your help.

We enjoy your publication and share most of the same concerns mentioned in the November/December 1982 issue.

Sincerely
Douglas R. Lowe
Fort Worth, Texas

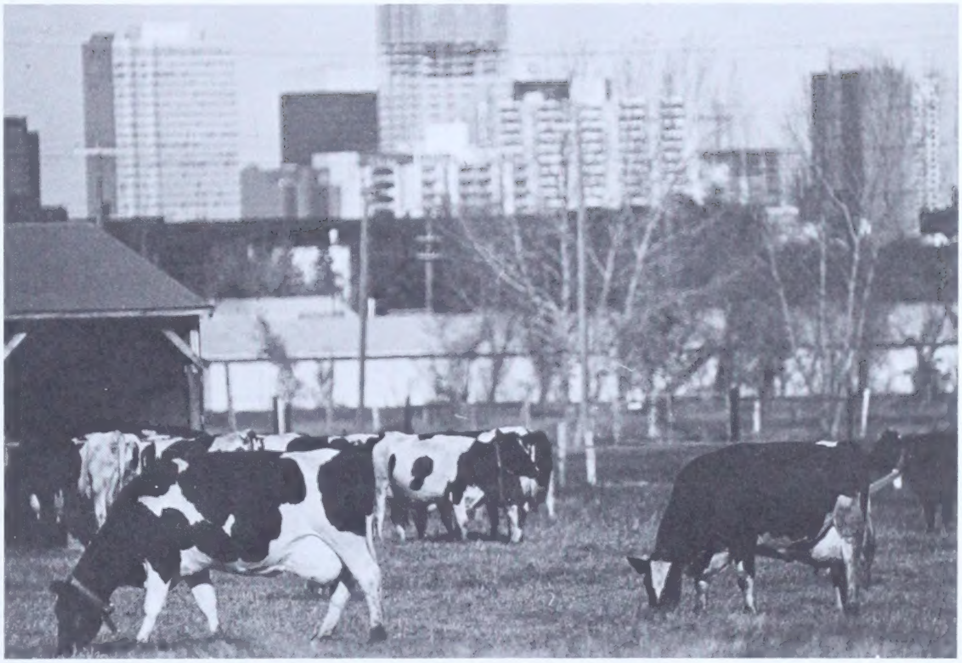
Editor's Note: Canola is the new term for rapeseed.

Dear Editor:

The recent issue of Environment Views entitled "Weather and Climate" has been received favourably by meteorologists in both managerial and operational areas. Important concepts and issues that complicate meteorology and climatology have been presented in a manner suitable for a general readership.

Atmospheric Environment Service, Western Region, certainly appreciates the cooperation received in obtaining extra copies of this issue for distribution within our service. Thank you and continued success with Environment Views.

Yours truly
B.M. Burns
Regional Director
Western Region
Atmospheric Environment Service
Environment Canada



Bill McKeown

Dear Editor:

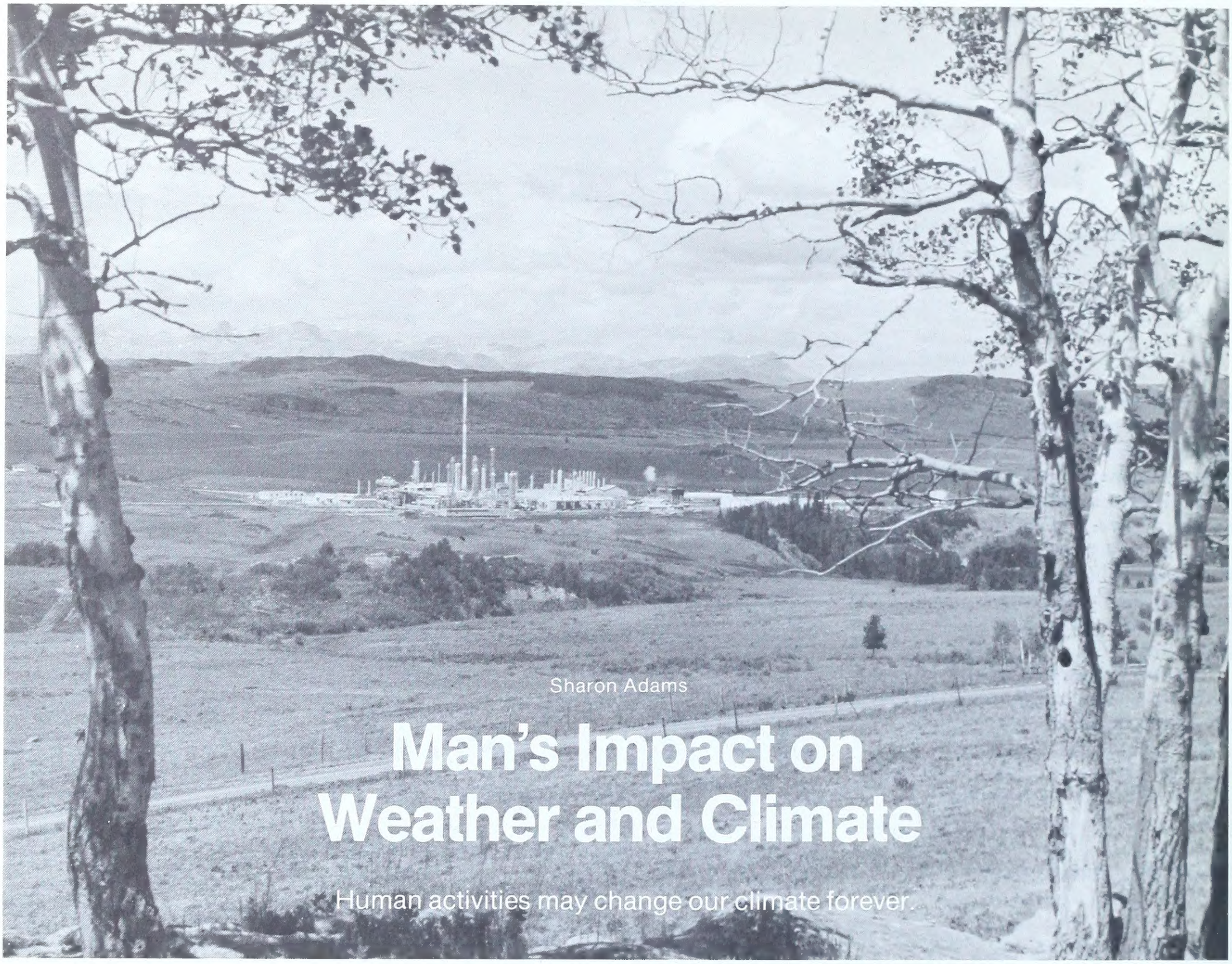
I am writing to congratulate you and your staff on the exceptionally fine job you are doing. I am a regular reader of "Environment Views" and feel it is one of the best publications available. It is refreshing and enlightening to read a publication that strives to present *all* points of view. The present format of dedicating each issue to one subject is very good. I find that this format gets me involved in the subject enough to read every article. I am quite happy, and somewhat amazed, to see a government funded magazine that is not supporting only the view of the party in power. I wish you luck in maintaining such status. Your general subject area; the environment, is much more important than most of us realize. I have been reading borrowed copies of "Environment Views". Please put me on your subscribers list.

Your recent issue on Agricultural Lands was outstanding. You obviously made an effort to look at the subject from every angle and the individual articles were very well written. This topic is of particular interest to myself as my family has been farming in southern Alberta for 75 years and are single tax advocates. I would like to start farming but the price of land prevents me. Our government, and the public at large, must realize that land is not a commodity, it is the source of all life. Therefore it cannot be treated like other commodities or life will be threatened. This issue of "Environment Views" is useful in educating people to this concept. Perhaps the time has come when the value that is imparted on the land by the community should be returned to the community, not the pocket of the speculator. I agree with many of the comments made by Mr. Kolkman. Could you provide me with the address of his organization?

Congratulations again on an excellent publication. Please keep us posted on the E.C.A. public forum on Agricultural Land use. Keep up the good work!
Yours truly,

Vincent J. Ellert

Editor's Note: The address of the Christian Farmers Federation is 110-10766 97 St., Edmonton.



Sharon Adams

Man's Impact on Weather and Climate

Human activities may change our climate forever.

Alberta Government Files

Sulphur emissions from gas processing plants have been linked to an increase in hail formation downwind.

Weather and climate have always had a dramatic effect on human affairs, determining where man settled, what kinds of culture developed — even how well cultures got along together.

For most of man's history, weather and climate were seen as immutable facts of life and man's effort at changing them was limited to prayer.

But in this century, for the first time, man is modifying the weather — deliberately, through such programs as cloud seeding, for example — and inadvertently, by burning fossil fuels, clearing forests and using aerosol sprays.

While deliberate weather modification is generally small-scale and is believed to have merely local, and usually economically beneficial, effect, inadvertent effects of man's activities could alter the climate and weather on a global scale.

But both deliberate and inadvertent effects of man's activities on weather and climate are difficult to observe, and harder to forecast.

International weather modification research has been going on since the 1940s. Alberta scientists have been involved since the 1950s in answer to farmers' concerns about hail crop damage and lack of water in dryland areas.

Today the Alberta Research Council (ARC) is involved in four projects: cloud seeding to produce rain in irrigation areas, to lesson hail damage, to produce snow to increase spring run-off and irrigation supply — as well as a study of an inadvertent effect on weather by sulphur emissions from gas processing plants.

Although Alberta has been involved in cloud seeding for hail suppression since the 1950s, and "on a significant scale" since the early '70s, "we really don't know if it works," says Renick.

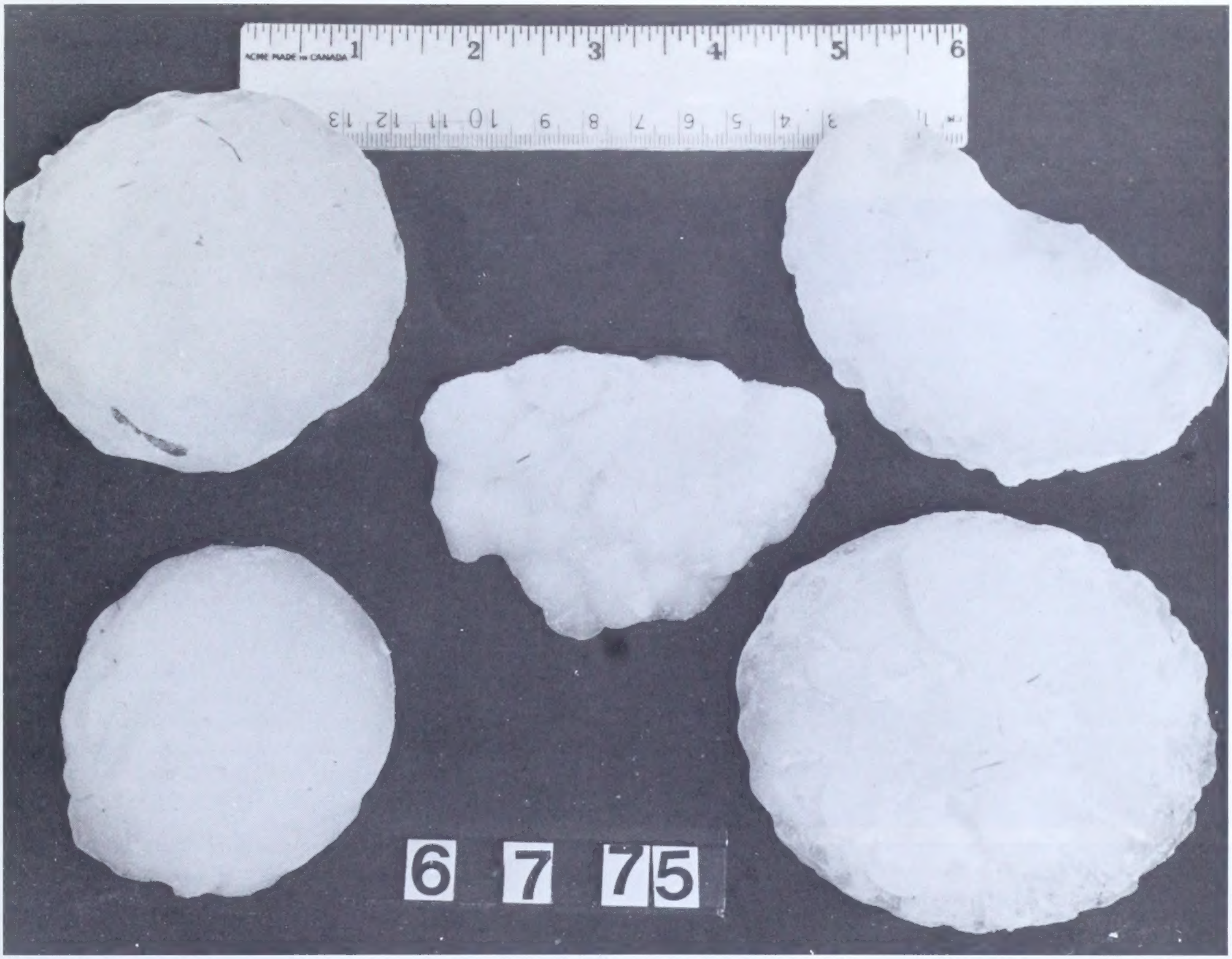
Despite decades of observation and research, scientists are hampered by man's age-old weather problem: unpredictability. Can lower hail damage rates after cloud seeding be attributed to man's efforts, or would nature have produced the same results through chance?

Hailstorms are notoriously unpredictable — large stones can beat one crop into the ground while across the fence a neighbor's crop goes unscathed. In addition, cloud physicists have difficulty gathering data within constantly-changing storm clouds and because of the storms' hit-and-miss nature, ground samples taken at sites as little as 1.6 kilometres apart give results accurate to only 50 per cent.

Still,Alberta suffers about $100 million in hail damage yearly, while cloud seeding programs cost about $5 million.

Cloud seeding is simple in theory: clouds are water vapor with a few ice crystals floating around. The water vapor condenses and freezes on the surface of these crystals, which grow and, depending on the type of cloud, weather conditions and the time of year, fall from the cloud as hail, rain or snow. When a cloud is seeded with a substance like silver iodide, the water vapor has an artificial crystal, very like the natural ice crystals, to condense and freeze upon.

In hail suppression programs, the intent is not to eliminate these ice crystals, but to



A sampling of hailstones from a 1975 storm.

Alberta Research Council

make more.

"We end up with more hailstones, but they're smaller," says Renick. Usually, but not always, these smaller hailstones do less damage than their larger, naturally-occuring cousins.

"Though we've been doing a lot of cloud seeding for hail suppression," he continues, "we honestly don't know if it works. In 10 to 20 years, maybe we can prove it. In the next couple of years we hope to know how seeding affects the cloud.

"The chance we've suppressed hail damage by 20 to 40 per cent is equal to the chance we've done nothing at all," he says.

Farmers, heartened by lower hail insurance premiums due to lower payouts in the '70s compared to the '40s and '50s, still back hail suppression, despite lack of conclusive proof that it works.

But results from "a new and small scale" rain cloud seeding program in 1982 look more promising, he says.

A dozen non-rain producing cumulus clouds in southern Alberta were seeded and "on a number of occasions we are convinced we produced rain while the unseeded clouds on the same day didn't."

Questions remaining to be answered before large-scale rain-cloud seeding is endorsed include how frequently clouds friendly to seeding occur, and whether the rain produced will justify the energy and expense of producing it.

George Isaac, chief of the cloud physics research divison of the Environment Canada's Atmospheric Environment Service, reports similar success with a 1970s field trial in seeding cumulus clouds for forest fire suppression.

The first trial, near Yellowknife in 1975-76, was "surprisingly beneficial." Seeded clouds produced rain.

"We spend about $100 million annually fighting fires," Isaac says, "and 800,000 hectares per year are burned. Most are large fires that cannot be controlled any other way than waiting for rain." Cloud seeding could shorten the the wait, the trials showed, but not consistently.

A similar trial near Thunder Bay, Ont., in 1977-78 was not as successful because the lifespan of the clouds was too short for ice crystals to complete transformation into raindrops before the clouds evaporated.

But AES recommended an orchestrated inter-provincial cloud-seeding project for forest fire suppression — a project which has never gotten off the ground.

"If we could get just half the clouds to rain (over forest fires), the cost-benefit ratio would be 30 to one," he says.

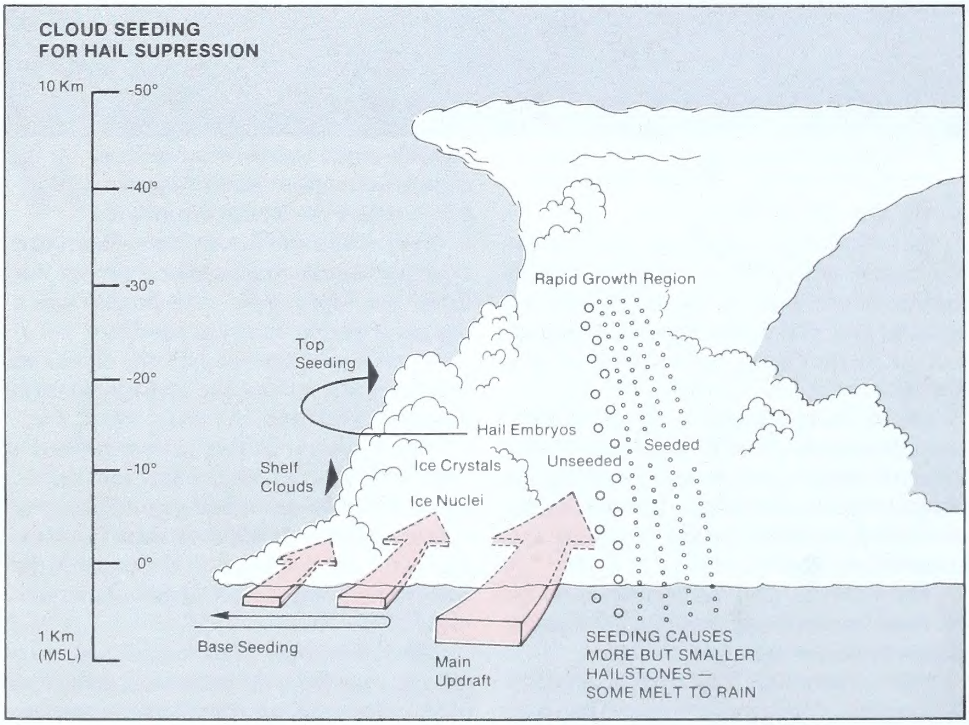
"The cheapest way to get water onto a farm is to have passing clouds rain on it," says ARC's Renick. "The second cheapest way is irrigation." And in Alberta the limiting factor for irrigation in the south is the size of the spring run-off of mountain snow melt.

The ARC hopes to use cloud seeding to increase snowfall in the mountains, and initial observations and measurements are encouraging. In the two-week period in 1982 when cloud conditions between Lethbridge and Cranbrook, B.C. were monitored, five days were cloudy and there was snow potential on one.

"If the potential is as large as it is in the United States," says Renick, "we may be

The Alberta Research Council's Jim Renick with cloud-seeding aircraft.

Alberta Research Council



CLOUD SEEDING FOR HAIL SUPRESSION

Alberta Research Council

able to increase snow pack by 10 per cent in the upper mountains and generate about as much water as is currently used in the whole irrigation project in southern Alberta (10^9 cubic meters)."

But actual seeding for snow production is some time off yet, he says. First, scientists must determine the potential of mountain clouds to produce snow, and then they have to determine the best method of producing it.

Renick believes weather modification should be explored before government commits itself to large-scale endeavors like the multi-billion dollar project to divert northern Alberta water resources to irrigate southern crops.

"In engineering terms, diversion is a very positive result, Though it's expensive, it can be done. At this point in weather modification, we just don't know."

But what will all this tinkering with the weather actually do in the long run? Though local weather modification programs are not expected to have more than a local, short-term effect, no one knows for certain. There has been little research into the effects of Alberta's efforts at modification.

"Of all the water vapor that passes over the province in the air, only about 10 per cent falls out. If we are able to increase that to 11 per cent, we've increased our local precipitation rate by 10 per cent, but have only taken one extra per cent out of the atmosphere."

Downwind effects are also likely to be small, because "weather systems which precipitate in Alberta are different from the ones that precipitate in Saskatchewan. So we can hardly be robbing our neighbors of rain.

"And remember," he cautions, "evaporation globally can replace all the moisture in the atmosphere in less than two weeks."

Though man's intentional efforts at weather modification are expected to have only a small and local effect, a debate is raging about serious weather and climate changes that may be caused as a side-effect of man's other activities.

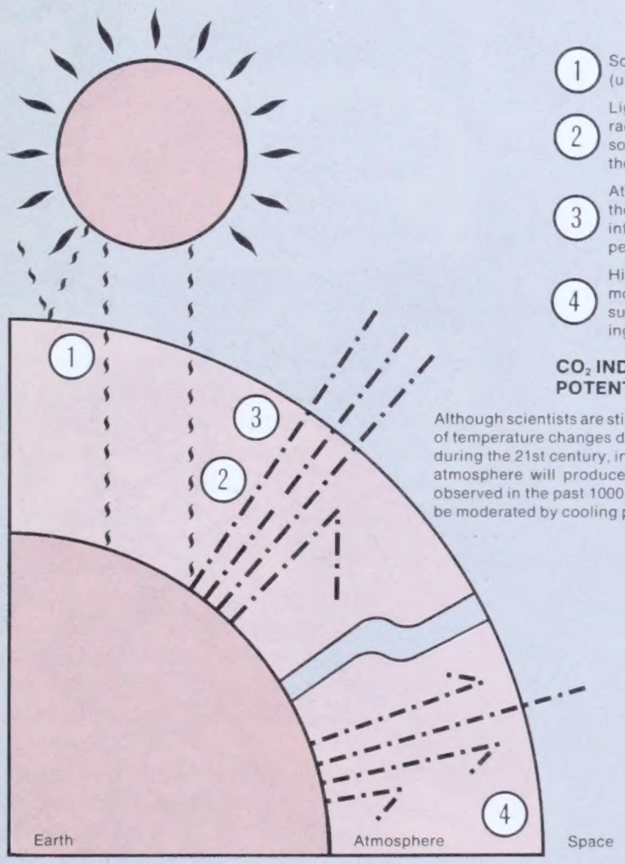
One such effect is an apparent correlation between sulphur emissions and hail downwind of gas processing plants.

"We've found a high correlation between crop damage and sulphur production," reports Renick. "As the sulphur goes up, the hail comes down."

But scientists aren't sure what causes the correlation. Could sulphur particles alter the precipitation process by acting as artifical ice crystals? Are acid rain clouds different from other kinds of clouds?

Scientists have just as many questions about the potential side-effects of man's contribution to "the greenhouse effect."

THE "GREENHOUSE EFFECT".



① Solar energy enters the atmosphere (unimpeded by CO_2.

② Light is absorbed by the earth. It is reradiated at longer heat wavelengths, some of which are captured by CO_2; the others escape into space.

③ At the normal atmospheric CO_2 level the quantity of light and heat escaping into space determines the earth's temperature and climate.

④ Higher concentrations of CO_2 trap more reradiated heat. Atmospheric and surface temperatures increase, affecting weather and climate.

CO_2 INDUCED CLIMATE CHANGE — POTENTIAL IMPACTS

Although scientists are still debating the timing and magnitude of temperature changes due to CO_2, they generally agree that, during the 21st century, increased concentration of CO_2 in the atmosphere will produce a global warming larger than any observed in the past 1000 years. However, the CO_2 effect may be moderated by cooling produced by natural phenomena.

Environment Canada

Carbon dioxide traps heat in the earth's atmosphere in much the same way panes of glass trap heat within a greenhouse.

The major source of earth's energy is the sun; of the enormous amount of energy which bathes the planet daily, some bounces off into space and some penetrates the atmosphere and is absorbed as heat by the land, oceans and, significantly, carbon dioxide gas in the atmosphere. If the earth is not to heat up like a fireball, getting ever hotter, it must lose as much heat as it gains every day — but as the amount of carbon dioxide builds in the atmosphere, so does the earth's capacity to hold more heat.

Since the late 19th century, carbon dioxide concentration has increased 15 per cent, while the global mean temperature increased .6 degree Celsius between 1850 and 1940. Careful observation by the Mauna Loa Observatory in Hawaii indicates carbon dioxide concentration is growing at a rate of .7 per cent annually — and the pre-Industrial level is expected to be doubled by the middle of the 21st century. The global temperature is expected to rise between 1.5 and three degrees Celsius for each doubling of the concentration of carbon dioxide in the atmosphere.

The sources of this extra carbon dioxide have been identified as the burning of fossil fuels and a simultaneous reduction of the world's stock of organic carbon in vegetation, the soil and the oceans.

Forests now cover about 33 per cent of the earth's land surface. This land, if cleared and cultivated, could help overcome a global food crisis which sees an estimated one in four humans facing hunger daily.

But destruction of the forests will release yet more carbon dioxide and as forest cover diminishes, so does absorption of carbon dioxide during photosynthesis.

To further exacerbate the matter, cleared land lets between 25 and 40 per cent more water percolate into rivers, so cleared land is more arid than forested. Changes in heat patterns, coupled with new run-off patterns could produce deserts where forests now stand.

A rise of one degree Celsius, claim some, is enough to melt polar ice caps, inundating productive and populous coastal areas, while on the other hand, an increase in temperature would push the boundaries of arable land far to the north.

An increase in the length of the growing season would benefit the U.S.S.R, which has suitable northern soils, but not Canada, with little soil outside the Peace River Valley good enough to farm if the growing season were lengthened.

And while northern Alberta may benefit from warmer climes, southern Alberta might suffer if an increase in temperature coincides with a decrease in rainfall, further straining an already limited resource — water. It is also not known whether increases in northern yields and more reliable harvests would compensate for losses in the south.

To further complicate the scenario, the earth is now in a "little ice age" during which a natural cooling trend is supposed to prevail. Few predictions have been made about how much that trend may ameliorate the greenhouse effect.

But one thing is certain: man now *can* do something about the weather — and is able to influence the physical and biological conditions of his future.

Sharon Adams is a Calgary journalism instructor and freelance writer.

Ron Duffy

The Weather and Health

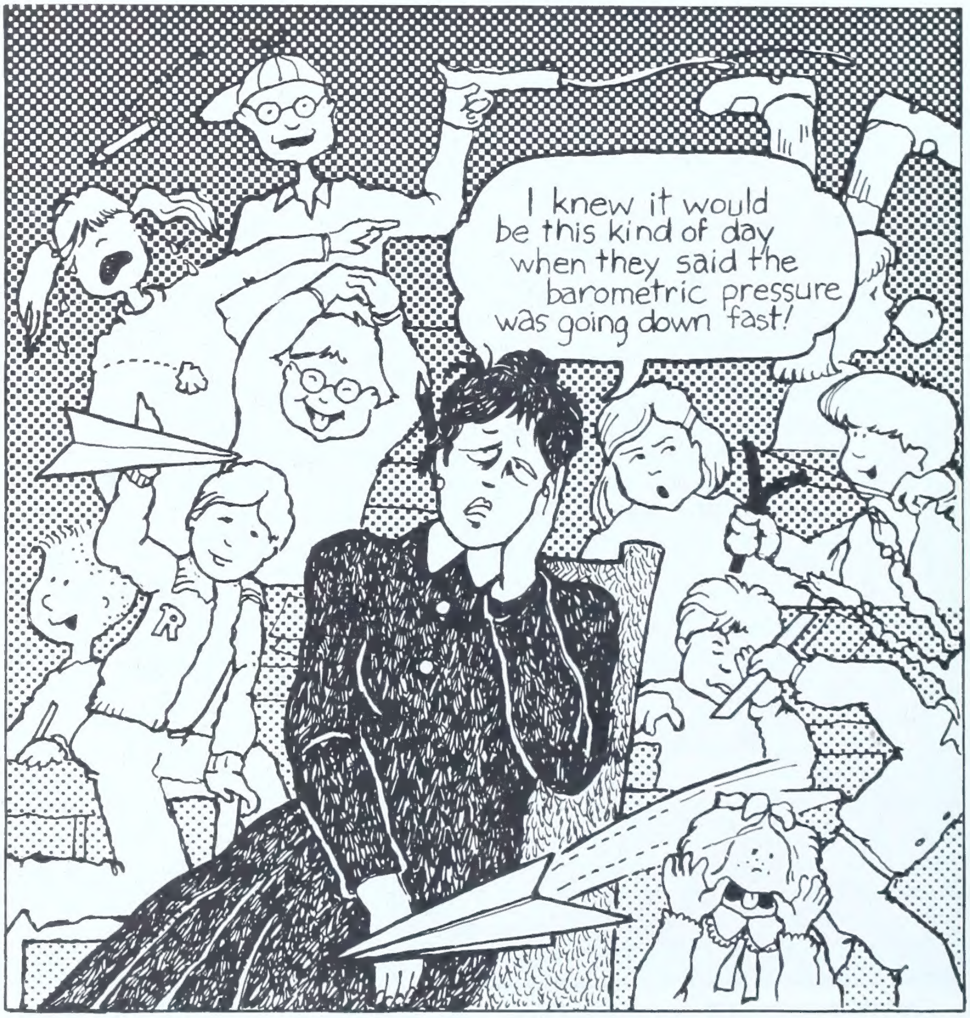
"In many ways, the rheumatoid patient is his own barometer."

Under the weather, you say. Indisposed out of sorts. Well, don't worry. Many people often are. But have you ever thought that you might be literally 'under the weather' - that is, under the influence of meteorological phenomena?

A coming storm your shooting corns presage,
And aches will throb, your hollow tooth
will rage.

You may have heard Grandma utter some variant of this ageless adage of folk wisdom. Or Grandpa, shuffling to his armchair, muttering something about swelling feet and a change to the south.

Don't immediately pooh-pooh the idea as a superstitious hangover from our animistic past. The more you study the influence of weather on health, the less it resembles superstition. Experts usually ascribe the origin of the idea to Hippocrates whose medical essays and aphorisms, written over 2,000 years ago, are brimming with references to the effect of weather on human health. But 2,000 years before Hippocrate the Yellow Emperor, Huang Ti, is credited with having written the Chinese medical classic *Nei Ching*. This *Canon of Medicine* makes several of the same kinds of observations as found in the pages not only of Hippocrates but of countless others from the fifth-century B.C. Greeks and Hindus to the modern researchers in biometeorology.


I knew it would be this kind of day when they said the barometric pressure was going down fast!
R

Martha Jones

Wait a minute, you say. What's this "biometeorology"? Well, like so much ancient speculation, from atomic theory onwards, our forefather's pronouncements on the ways in which weather controls health have come under the scrutiny of modern scientists. They have christened their infant science biometeorology.

Their research has linked changes of weather with a wide variety of symptoms including apathy, exhaustion, insomnia, depression, confusion, blood clotting time, white cell count, hormone production, and vitamin and mineral levels in the body.

"Virtually every function in the body is affected by the weather," according to Solco Tromp, founder of the Biometerorological Research Centre at Leiden in the Netherlands.

At the Third International Conference of the International Psychosomatic Cancer Study Group in 1963, Dr. Tromp included even cancer.

"As it is almost certain that in most neoplastic diseases serious disturbances may play a very important part," said Dr. Tromp, "it seems possible that meteorological stresses could be able to affect neoplastic diseases."

Medical geographers have suggested that climate may be a factor in the unequal distribution of cancer in Alberta. Cancer researchers are more sceptical.

"We don't know about cancer and climate," says Gerda Bako of the provincial Cancer Hospitals Board's department of epidemiology. "We didn't look much into the question for at the moment there is no known connection."

If there is a connection it may be found in the impact of stress on the human body. World-famous expert on stress, the late Dr. Hans Selye of the University of Montreal, himself a cancer sufferer, taught that a stress reaction can be caused by physical pain, emotional distress, infection, physical injury and not least of all by weather.

Any change in the physical or psychological environment causes stress which then imposes demands for adjustment on the body. Prolonged or excessive stress may overtax an individual's resources and lead to a breakdown of organized function. Herodotus, 2,500 years ago, was aware of this. "Diseases almost always attack men when they are exposed to a change," he wrote, "and never more than during changes of the weather."

The important factor is change in weather patterns, not changes in individual weather elements, concluded researcher Allan Nursall in a report on the study of the effects on weather on migraine headaches.

In a study, undertaken at the Canadian Climate Center at Downsview, Ontario, Nursall found a marked increase in the frequency and severity of headaches during the weather phase associated with the passage of a warm front, when barometric pressure is dropping and temperature and humidity reach their highest values.

"Repeated observations have shown this phase to possess a markedly aggravating effect on most chronic ailments, Nursall said. In the list he included stroke, thrombosis, gastritis, meningitis, bronchitis, diabetes and many more.

If any one weather element can be isolated from this pattern as having a greater effect on health than any of the others, it would be falling barometric pressure. Its impact on people ranges from slight to catastrophic.

The reason is that the internal pressure of the body depends on the external pressure of the atmosphere. When the external pressure falls, body tissues swell and thus reduce the flow of blood to the brain. The heart has to work harder to compensate, and the pulse rate rises. The result is extra pressure on the brain and strain on the heart.

Observations around the world suggest that a period of falling pressure increases irritabilty, exhaustion, inattention, headaches. This is the time when conflicts between couples are most often triggered, when schoolchildren are more likely to be unruly in class and to indulge in vandalism outside it. This is the time in Tokyo when Japanese leave thousands of umbrellas and package behind them in phone boxes, stores, buses, restaurants. This is the time in Switzerland when industrial accidents jump by 20 per cent.

Andrew Vaughan

Roy Fletcher

In Frontenac County, Ontario, this is the time when 81 per cent of fatal road accidents and 73 per cent of others occur, Queen's University surgery professor William Ghent found. His local observations appear to have a global validity. In West Germany, for example, the cause and effect relationship between falling barometric pressure and rising traffic accidents has been given official recognition. The German Weather Bureau issues a 'bioprognosis' as a warning to motorists who are then expected to exercise special care to compensate for diminished capacities.

Falling barometric pressure, along with rising humidity, has nearly constant detrimental effect on rheumatoid arthritis and osteoarthritis.

"Changes in barometric pressure," says a spokeswoman for the Arthritis Association in Calgary, "may make arthritic joits ache more, but they do not affect the disease itself."

It seems that the expansion of blood vessels under conditions of low barometric pressure causes pain in rheumatic or arthritic joits. Support for this theory comes from US Navy divers who report easing or total disapperance of arthritic pain under the high-pressure influence of deep water.

Storms appear to be associated with increased rheumatic pain more than 90 per cent of the time; major changes in barometric pressure about 70 per cent.

"There's no doubt that in many ways the rheumatoid patient is his own barometer," says the Arthritis Association.

This is common among suffers from rheumatism and arthritis: nine out of ten of them are highly weather sensitive. In the population at large, one in three is equally sensitive to weather changes. Of these, women are more sensitive than men, and people over fifty more than those younger. All are in good company. Napoleon, Mozart, Michelangelo, Goethe and Bryan were similarly afflicted.

One common weather change that causes discomfort in weather-sensitive people is the chinook-type wind.

"The hot winds of ill-repute," biometeorologist Dr. Felix Sulman of Hebrew University in Jerusalem has called them.

In many parts of the world, he reports, these "witches' winds" - chinook, Foehn, sharaz, etc.-"affect mental and physical well-being and may constitute a factor in provoking migraine in weather-sensitive patients."

Abundant research from Europe has associated the Foehn wind not only with migraine but with ordinary headaches, depression, discomfort, irritability and exacerbation of respiratory conditions. The heat, the dryness and the surplus of positively charged electrical ions that characterize the atmosphere under the influence of these winds cause the body to lose fluids and to gain potassium, thyroid and serotinin. The excess potassium is more or less toxic and may affect the heart muscles; the extra thyroid can cause an assortment of symptoms including hyperactivity combined with exhaustion; the increased serotinin, the compound that induces mus-

Bill McKeown

Mark Solomon

cular contraction and constriction of blood vessels in various parts of the body, can bring on irritability, giddiness, insomnia, depression and uncharacteristic behaviour.

University of Lethbridge bioclimatologist Dr. Roy Fletcher has spent two years studying the health effects of the chinook. He is on record as saying that this Rocky Moutain wind has no effect on the people of southern Alberta, but now he says that his statement to the local press and radio may have been premature. "One reason why my results differed from those in Europe may be that my sample was too small. I have much more work to do. I have a hunch that more research will reveal higher rates of emotional disorders in the pre-chinook period."

One established result of weather changes like chinook winds and falling pressure is depression. Depresssion is a psychological phenomenon associated also with the long months of winter, with or without chinooks. Regina psychiatrist Dr. Andre Masters has said that many people sink into depression during the winter. "But the malaise doesn't manifest itself until flowers bloom and the birds chirp."

The result may be "cabin fever": a deep depression which, if left untreated, may lead to suicide.

"The monthly rate of suicides in Canada shows a very distinctive annual pattern," says Simon Kevan, a sociologist from John Abbot College near Montreal. "During the months of April, May and June there is an increased number of suicides, while during the months of December, January and February the incidence is relatively low. That same annual distribution of suicides can be found in many of the countries which have a similar climate to Canada's."

Dr. Mark Solomon, owner of Bereavement Services in Edmonton and an expert on suicide, maintains that no statistically significant relationship exists between climate and suicide. "The traditional increase of suicides in spring," he says, "is not due to the climate but to the way people relate socially. People tend to commiserate with each other in winter and give each other encouragement. In spring things tend to get better for everyone but the potential suicide. They cheer up, but he doesn't. The social support of winter is withdrawn."

So beware. After the Ides of March come the suicides of April, May and June.

Dr. Solomon adds that Alberta the effect of the chinook on suicide is "doubtful." Edmonton, he points out, has a higher suicide rate than either Calgary or Lethbridge.

Dr. Menno Boldt, a University of Lethbridge sociologist who has done extensive research on suicide, agrees with Dr. Solomon that higher suicide rates in the spring have a sociological, rather than meterological, explanation. He says there is no measurable correlation between weather conditions and suicide rates.

"But that doesn't mean there is no connection at all. When people have to face day upon day of 80 kilometre an hour winds as they do here in Alberta, they get depressed. It is starting to have an effect. The same with rain on the west coast or the long dark nights up north. It is only logical that these adverse weather conditions should deepen depression in susceptible people, and depression leads to suicide."

Does all this still leave you under the weather? Well, cheer up. Every third person you meet is probably under the same cloud. And remember that the weather itself may be the only reason for your being out of sorts. That should be reassuring.

Ron Duffy is a former geography lecturer and researcher, now doing freelance writing and research.

Jim Wilson

Designing for the Weather

Making the best of a tough climate.

Once upon a time all you had to do to erect a shelter in Alberta was cut down a few slender trees, fix them together at one end, stand them up and wrap some hides around them. Presto, one uncomplicated home, no muss, no fuss, no bothersome regulations to worry about and not a lot of insulation or draft-proofing, either.

Even as little as three years ago, designing a home or office building for Alberta's peculiar climate was largely a matter of how you interpreted a few simple building code regulations. Cheap and plentiful natural gas took care of any weaknesses in the cold-climate portion of construction procedures, and on a hot summer day you simply put up with it, sat on the porch or went to the lake.

Today all that's changed. Regulations have been strengthened so that they don't simply reflect a need to keep interiors warm. They also specify how to design for it. Fuel is still plentiful, but more expensive and we've recognized it's a vanishing resource. We've discovered air conditioning and expect our homes to be comfortably cool in the summer. Environmental concerns are forcing architects and engineers to design buildings and recreational areas with conservation as well as comfort and esthetic considerations in mind.

"Designing for the weather in Alberta has become pretty important today, and it's a tricky problem," says Dixon Thompson of the University of Calgary's faculty of environmental design. "Some places have only relatively minor shifts in conditions — we have a very broad range of changes to contend with."

Whether it's clothing, a home, office, warehouse, recreational facility or park, or even a transportation system, anything designed for practical use in Alberta must take into account seasonal shifts in temperature ranging from minus 40°C. in winter to above 35°C. in summer. In southern Alberta, designers must cope with the dozen or so false "spring" thaws that chinook winds can bring, warming buildings, roads, gardens, trees and hibernating animals. During the summer there can be up to 20 hours of direct sunshine and light, striking surfaces at relatively short angles. During the winter, this drops to 10 hours or less — and the angles are very long.

"In terms of structural design these factors affect how we look at the siting of buildings, location of windows, the types of materials we use, where we locate wind breaks, the types and designs of solar heating systems we can employ and so forth," Thompson says. "But we also have to remember how the changes affect biological systems — our own moods, general growth rates, photosynthesis, wildlife survival and our choice of trees and shrubs in landscaping."

In fact, designing for Alberta's weather is important at virtually every level of our lives. Most of us have heard the horror stories about the poor quality of heaters in some early European and Japanese import

Tang Lee

Tang Lee, a professor of environmental design at the University of Calgary demonstrating the working of a solar receptor on his energy-efficient home cars, and of car door handles that became so brittle in the cold that they cracked and broke. Even logistics must be designed for local weather: the Edmonton Journal once received a shipment of computer terminals from Florida which were damaged by freezing in unheated freight cars.

"I guess the whole thing in Alberta is to look, think and plan very carefully before you leap," says Calgary landscape architect Brian Dodds, who has among other credits designed two major botanical projects for the Venezuelan government.

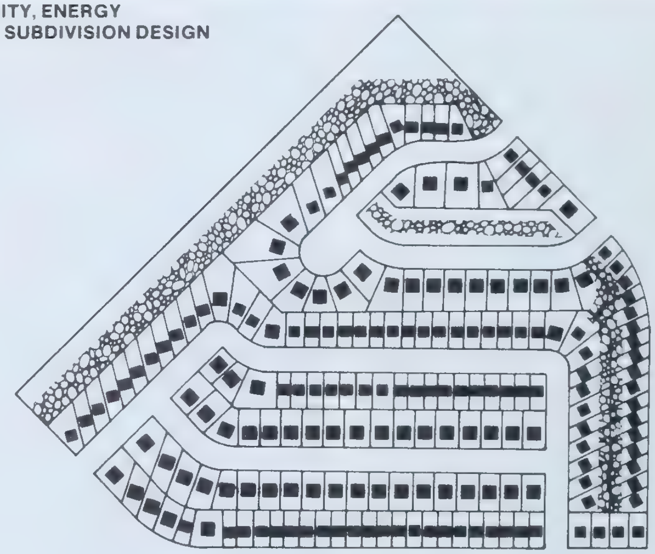
That close look may become more crucial in years to come. Canadian Climate Planning Board chairman Kenneth Hare says Canada should be on a "yellow alert" in preparation for a significant change of climate within the next 50 years. And no matter whether that change moves us to warmer or colder lifestyles, he points out, some sectors of our economy will suffer a loss. Readjustment will be easier, he says, for those industries and people who have been planning and designing with the weather and climate in mind all along.

Stephen Tyler, manager for policy analysis and liaison at the energy conservation branch of Alberta Energy and Natural Resources, thinks we should begin with the creation of the places we live — residential subdivisions.

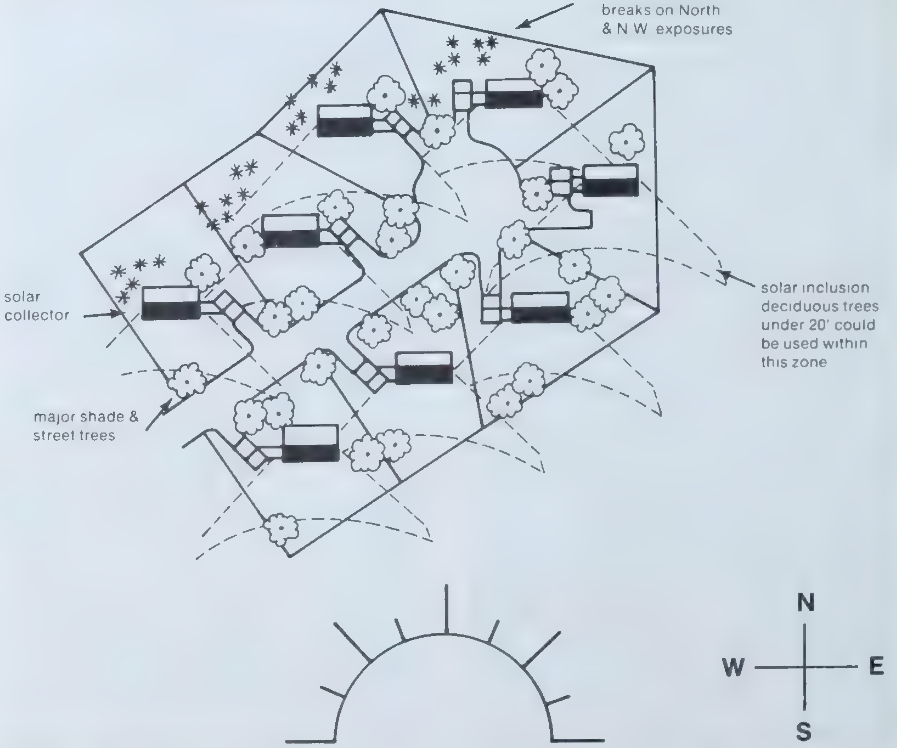
"Subdivisions are designed in today's curlicue patterns because developers have found they can cram more lots into them that way than if they're arranged in the older grid patterns," Tyler says. "That's not necessatily bad. The real problem is that no matter how subdivisions are designed, they're put together as though climate wasn't a significant factor. The result is that a few houses have a good location and exposure, but most houses have something from bad to terrible exposure considering the sun and the climate."

More consideration of such factors by developers and use of sharper pencils by approving authorities, he says, would improve the situation — and since the work would be done in advance and on paper, the

LOW DENSITY, ENERGY EFFICIENT SUBDIVISION DESIGN



POSSIBLE SOLAR SUBDIVISION LAYOUT


evergreen wind-breaks on North & N.W. exposures
solar collector
solar inclusion deciduous trees under 20' could be used within this zone
major shade & street trees
N
W
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Alberta Energy and Natural Resources

Dixon Thompson

only additional expense would be employing designers who know something about environmental design.

Local climate, precipitation variations through the year, prevailing wind directions, sunlight hours and angles and the general surrounding terrain are all important design factors, Tyler says. Lots could be designed with unusual shapes, or could be run at an angle to the street instead of perpendicular to it. Different set-backs would provide better access to the sun for most houses.

"Even with these design methods you might not get every building optimally sited," Tyler says "but most of them would be." And the next design aspect would take care of most of the exceptions: actual housing construction techniques. For example, if the front of the house still ends up facing into cold north winds, flip the floor plan over so the larger windows are at the back of the house, facing south.

Tyler admits the consumer is a major part of the problem here: while some people might be happy looking out a living room window into a private back-yard space, most still seem to prefer the traditional picture-window-on-the-front-yard approach.

Other siting preferences include sheltering the north side of the house with evergreen trees for a winter windbreak; use of deciduous shade trees at the south, providing shade in summer when their leaves are out and letting the weaker sun radiation through in winter when they're leafless; windows sited for good summer ventilation; entry airlock vestibules; good weatherstripping; good insulation throughout; and double or even triple-glazed windows.

Most of these are covered in one way or another by provincial regulations, says Ron Axelson, of the Housing and Urban Development Association of Canada. "The regulations are also designed to make certain the furnace can heat the house; rain run-off and snow melt-off water has to drain away from your yard but not into your neighbor's – these things really haven't changed much in years."

But even if the almost-perfect subdivision were created, high-technology landscaping and solar designs could be used to take yet more advantage of the weather. Tang Lee, a professor in the U of C faculty of environmental design, has just built a new home that's full of weather consideration. By utilizing passive solar heating systems, siting the house and windows for the full benefits of solar radiation, protecting the house from cold winter winds with berms and trees and using the best available insulation and weatherstripping techniques, Lee says he's made his house so energy efficient that he can heat its 280 square metres for just $250 a year.

"You don't have to have a somewhat esthetically unpleasant house to do this, either," he says. "In the past when most of the solar houses were designed by engineers they were functional and efficient — but not necessarily pretty or comfortable. Today there are architects with the skills needed to make solar designs work, and who also have the talent and experience to make them attractive and comfortable living places."

Jack Long

Calgary architect Jack Long goes one step farther: he considers it mandatory to design Alberta structures to both cope with and benefit from the province's climate. In addition to Lee's approach, Long adds such niceties as wind generators and solar collectors for electricity and believes many old-fashioned designs like verandahs surrounding and protecting the house will return. However, he adds the concept of "life-cycle economy" for Alberta construction: "Don't," he warns, "limit your house payments but not your utilities bills. Design for the best all-around benefits."

Albertans pay more for construction work than those in more temperate climates. Ron Staple, manager of the Proctor & Gamble pulp mill in Grande Prairie, says a plant of the same design built at the same time in Florida cost about 25 per cent less. "The Florida plant has the same structural support steel and tanks and that sort of thing," he says, "but except for the control rooms and some places where special processes have to be protected, there are no outer walls. Tanks and equipment are simply suspended from the steel beams. For our plant, we have to have walls, lots of insulation —lots of protection from the cold."

And HUDAC's Axelson agrees: "It's difficult to put numbers on it because factors change from year to year," he says. "But you have to realize that in a place like California you can almost see through the roofs —they don't have many regulations about trusses and snow load factors there. I think designing for the Alberta climate probably costs about a quarter of the construction price of the average house here."

The actual dollar differences are staggering: Staple says his Grande Prairie plant cost about $100 million to build a decade ago, and would cost three times that to replace.

And Tang Lee adds another cost. Since there are more kinds of materials involved in putting up a building in Alberta, there are more construction trades involved — and therefore more labor charges. "And don't forget the problems of winter work," he says. "Not only do we have to protect workers from the cold and heat unfinished buildings, but we also have to accept that people simply aren't as efficient workers when they're cold or dressed in bulky protective clothing."

(In this regard, things may be improving: the importance of designing clothing for Alberta's weather is shown by the emergence of several manufacturers in Alberta. One of them, Sun Ice Ski & Sportswear Manufacturers in Calgary, designed the special equipment used by Canada's recent Mount Everest expedition. The Thinsulite materials used are light, strong and can be made into warm, efficient and attractive clothing.)

Curiously however, some things we'd expect to be more difficult to design really are not — they're just a bit more expensive. Topping this list would be utilities systems requiring excavations. Electrical and telephone lines don't have to be handled any differently here than in warmer climates, and water and sewer lines must simply be buried below the frost line. They can even be laid in winter with modern equipment – and a little bit of heat created by the expedient of burning straw along the excavation line.

Susan Brun

Brian Dodds

Landscaping, too, is relatively simple. "It sounds a bit harsh," says Tang Lee, "but if trees and shrubs can't survive our temperature range and repeated thawings because of chinooks, they die — and that's the end of it. The plants that survive have survived for years, and they're strong enough for this climate."

There are always experimental plantings in progress by nurseries and other interests, but according to Brian Dodd the important thing is to know the microclimate of the precise location involved. Some trees, for example, can't survive being planted in the front yard on the north side of a house, but will do well on the south side, where they get just enough protection from the elements.

And Dodds extends this to larger projects like parks — and ski resorts.

"You look at the whole situation and decide what you can preserve, not what's new that you can plant," he says. "You study the conditions and should realize that they're what's natural to the area — if there's a lot of rain, for example, you plan for rain, not sunny days. And if there's little or no snow one year in three, you expect that one year in three there will be no snow and there's little you can do about it."

The major environmental factor in designing for weather in Alberta is snow and its ice and water aliases. Parkade ramps, for example, must have a shallower grade here, or else have buried heating cables or infrared heaters above them to keep the slippery frost away. And roof trusses and rafters must be designed to take snow loads of up to 300 kilograms per square metre — just in case the wind creates heavy drifts or a blizzard hits. That's the equivalent of designing them to hold a complete second storey.

Transportation systems are particularly susceptible to poor design during winter.

Trains (and Edmonton and Calgary light rail transit systems) must rely heavily on excellent track-clearing after snowfalls. In the mountains, snowsheds protect rail lines and highways from avalanches.

But snowsheds are probably the most dramatic example of transportation weather design problems. "We don't really build highways and bridges all that differently here than they do in other climates," says K.E. Howery, operational design director for Alberta Transportation. "The difference is that we have to be particularly cogniscent of what the weather can do. We have a lot less leeway."

One simple example: Where there's no expectation of ice or snow, it's perfectly safe to build a highway with a controlled intersection crossing it on a steep hill. But if you do it in Alberta, it only works until the first time a car is stopped at a red light and can't get started again because the hill is covered with ice.

"We also have to keep as smooth-flowing a cross-section as possible in highway design," Howrey says. "We try to avoid anything that will catch the blowing snow and let it build up on the road. We're a lot better off in that regard than they are in the city where they have to have curbs, gutters and fences along the roads, and they'll catch snow all the time."

Materials used in road design and construction are also a special concern in Alberta. Gordon Berdahl, Alberta Transportation's material design engineering director, points to three particular problems which designers must attempt to minimize: frost heaving (caused when moisture caught in the subgrade portion of the roadbed during construction expands when it freezes); frost boils (hollows in the subgrade caused when frozen moisture finally thaws and migrates downward, leaving hollows under the asphalt); and thermal cracking (caused by expansion and contraction of the asphalt surface itself).

Berdahl says soft, high-viscosity asphalts must be used here — and that fortunately Alberta has a wealth of materials required to formulate them.

"But you're really walking a tightrope here," he adds. " You have to decide where to draw the line in coping with the winter freeze problems, because if you go too far you'll create even more problems when summer comes and the asphalt gets heated by the sun all day."

He says the same problems must be faced in construction of airport runways, but they are compounded by the fact that the enormous areas that are paved are extremely difficult to drain, making frost heaves and boils even harder to avoid. Thermal cracking is also aggravated by such a large, thick surface, and together these become dangerous, because a runway must be much smoother and stronger than a highway. In Alberta's climate, he says, extreme care must be taken in airport design to minimize these factors right from the start — including site selection specifications.

To say that bridges must be designed for weather considerations in Alberta becomes almost an understatement. Bob Foster, assistant chief bridge engineer for Alberta Transportation, says it's critical to design bridges so they can resist the crushing force of flowing cakes of ice during breakup, and to a lesser extent resist the pressure from the expanding ice layer itself when it forms around piers.

"Materials behave much differently at low temperatures, too," he says. "There are thermal movements that the bridge structure must be able to cope with no matter what the climate, but in Alberta we have to accommodate a much larger total movement because we go from such cold temperatures to such high ones."

This means bridge designers must consider special materials for bearing and expansion joints, and some products can't be used here because they become too stiff at low temperatures."

"We also have to be more careful in selection of steel to choose it for greater notch toughness — a greater ability to absorb energy without cracking, because that ability drops with a drop in temperature."

Lest all the above makes it appear there's nothing but negatives concerning Alberta's winters — at least from a weather design viewpoint — there is another side to the story: we're not alone in having to consider special climatic circumstances, and there are times when the province's annual cold snap can be a distinctly positive event.

Architect Jack Long points out that Alberta (and other northern jurisdictions) have a cold-and-snow problem, but such places as Arizona, pleasantly warm though they are, require major efforts to protect people from extreme solar heat and also against dust. In B.C. the snow isn't as extreme a problem, particularly on the coast, but rain by the bucket creates its own set of weather design difficulties.

And other areas have their local problems and solutions. In Hyderabad, Pakistan, for example, summers are unpleasantly hot. So the townspeople years ago came up with an inexpensive air conditioning system: They mounted box-shaped windscoops on top of their houses, facing toward the prevailing winds. Now the least little breeze is captured and funnelled down into the living quarters — for free.

Cold, if used properly, can be of immense benefit. "When you have to put a road across soft, wet, muskeggy areas you're better off to design it as a winter project," says K.E. Howery. "In fact you can build a road in winter when it would be nigh unto impossible to do it in the same place in the summer — but then that road can be used year-round."

And his bridge-building colleague Bob Foster says river ice can frequently be a distinct ally. Bridges are designed so they're immune to the ravages of ice before they ever leave the drawing board, so workers have no concerns there. But they need strong platforms to dig into the riverbed from, and by flooding existing ice surfaces with river water to thicken it, they end up with a beautiful working platform at almost no cost.

Tang Lee believes our houses and most other buildings are somewhat stronger than those in most other climates because the cold weather makes it necessary to be more careful during design and construction and because there are more stringent regulations. ("That's not saying they'll last longer," he hastens to say. "They'll just stay comfortable longer under extreme circumstances.")

But perhaps the best indication of the positive potential value of Alberta's winter is a historic note from the Ellision Milling Company flour mill in Lethbridge. Until a few years ago the mill used freezing tempertures as a natural annual exterminator..

"We'd spend a lot of time organizing it, check with the weatherman and then one day we'd shut down all the water systems, open all the windows in the plant for a few days and set up big fans to bring in the cold air," recalls maintenance superintendent Albert Bourassa. "After a while it would be colder inside than it was outside, and it killed every bug or insect in the place."

Like any large building, the mill still has a few insects lurking about on its premises during the winter, seeking their place in the warm. But lest modern-day specialists create a whole new school of weather design, listen further to Bourassa's story: "It's certainly cheaper than other forms of extermination," he says. "But you'd better consider the affects of an unexpected chinook in your planning. The last time we did it we opened everything up when it was about -40°. Then a chinook blew in and by the time we had the place shut up again it was as balmy and dusty as a windy summer day."

Jim Wilson is a Calgary freelance writer and editor

The Influence of Climate and Weather on Agriculture

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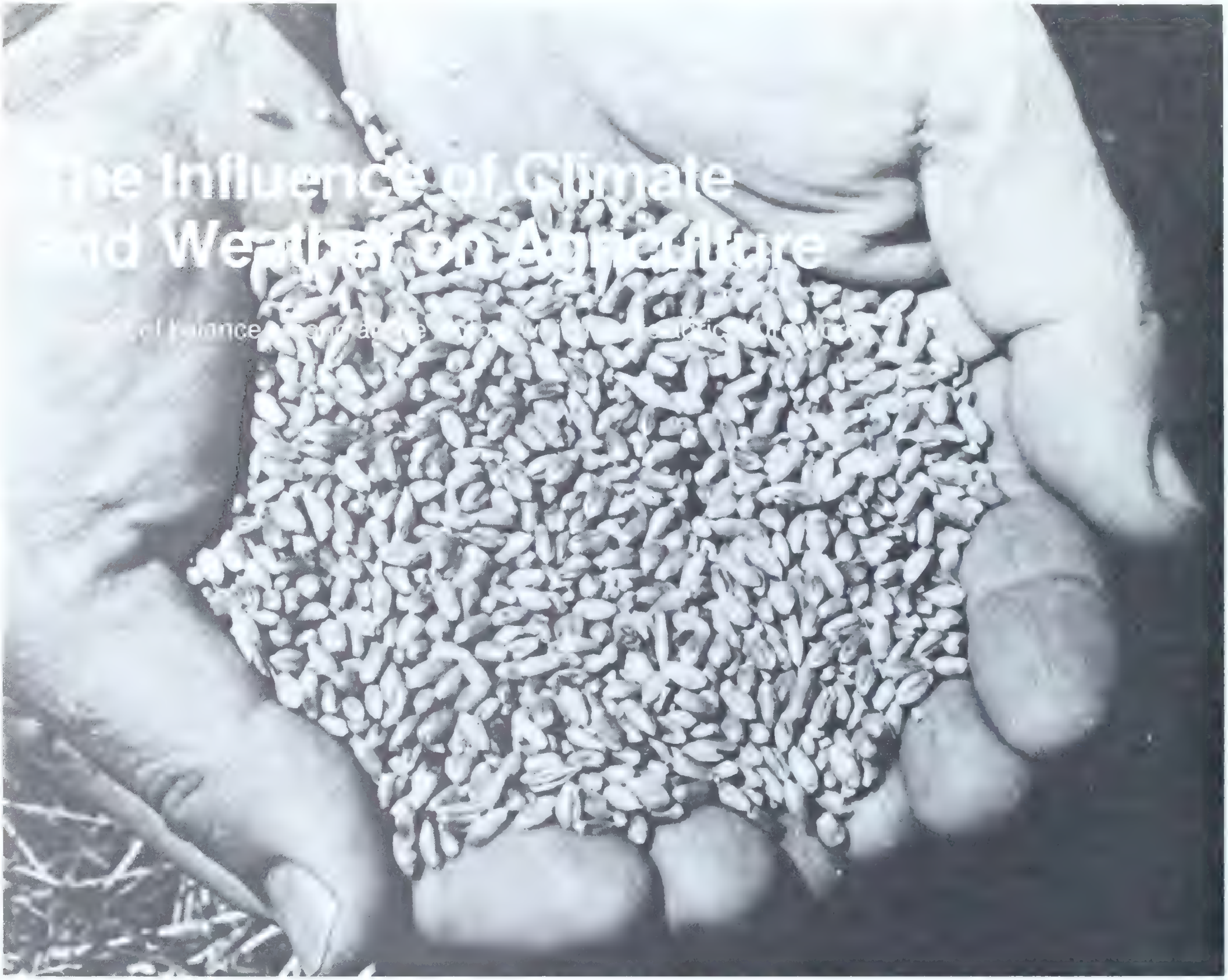


Weather affects all aspects of people's lives. But nowhere is its influence felt more strongly than in agriculture.

Rain or the lack of it, the number of frost free days and the breeding conditions for insect pests are all factors that can mean the difference between a profitable year for the farmer and disaster.

Agrometeorologist Conrad Geitz explains that five weather factors are the most critical for agriculture in Alberta: moisture supply; temperature; the period of daylight; frost; and interannual variability.

Moisture supply, says Geitz, is a product of two things, precipitation and evaporation. Drought conditions prevail when evaporation exceeds precipitation. Every year in Alberta, says Geitz, some area will experience some degree of drought. South-eastern Alberta suffers most but northeastern Alberta is also susceptible, says Geitz.

Not only the amount of rain is important but also when the rain occurs. Rain in the spring will provide moisture for the new crop while heavy rain throughout the summer may wash it away. Rain in the fall helps provide subsoil moisture for next year's crop but if that rain comes too early it can disastrously delay harvesting operations. Dry years also encourage the growth and development of insect pests.

For example, says entomologist Helen Liu, grasshoppers, which are the most prevalent and destructive of the insect pests that prey on Alberta's field crops, can be virtually wiped out by heavy rain in early spring.

"If these rains hit when the little hoppers have just hatched and aren't very strong, they'll drown," Liu explains.

However, dry weather can also have an adverse effect on the hoppers' life cycle, depending on when it comes.

"If you have a dry fall when the grasshoppers are preparing to lay their eggs, there will be very little grass for food and they won't lay so many eggs. The ideal weather conditions for controlling grasshoppers, then, would be a cold, moist spring and a dry late summer and fall," says Liu.

Wet weather can also inhibit the growth cycle of animal parasites, says Dr. Wilbert Haufe, parasitologist and biometeorologist at Alberta Agriculture's Lethbridge Research Station.

"Wet weather will inhibit the flight of the second generation of some insects so they can't fly, disperse and mate as widely as they might have." The second variable that affects Alberta weather - temperature - also has a profound influence on the development of both plant and animal parasites.

Haufe has shown that an animal's pattern of resistance varies with the temperature and that the periods of infestation of adapted parasites (those that live on the host animal) uniformly follows the cycle of resistance. Cold weather will lower an animal's resistance and result in a greater infestation of the parasites.

"Temperature also has a dramatic effect on free-living parasites such as blood sucking flies because they have no shelter," says Haufe.

The insects may be killed by the extreme cold or their development may be significantly arrested, the parasitologist says.

Windbreaks are planted in areas where conservation of soil moisture and the reduction of wind erosion are crucial

Temperatures have a similar impact on insects that feed on field crops, says Liu.

"If, for example, you have an early, mild spring and the insects hatch and this is followed by a sudden cold spell and a period of frost, the pests will have a high mortality rate."

Temperature, or more specifically, the amount of radiation received from the sun, is also crucial to the growing season. As might be expected, the heat available for crop growth diminishes as one moves from south to north.

However, another climatic variable, the length of the daylight period, also comes into play at this point.

"We are at an advantage in the north because of the longer days," says Geitz, "Although this does not compensate entirely for the lack of energy."

But Peter Mills, an agrometeorologist at he Beaver Lodge Research Station west of Grande Prairie, says the longer days in northern Alberta "offset quite nicely" any problems caused by the lack of radiation.

"There are a lot of farmers up here with piles of grain sitting in their front yards because their granaries are full," says Mills.

A problem that does affect northern agriculture, however, is the length of the growing season.

"When the frost-free period is shorter, obviously the range of cropping options is less," says Geitz.

"There are some crops that are grown in southern Alberta where we can usually depend on more than 120 frost-free days that simply can't be grown in the north where the frost-free days may be fewer than 90."

Interannual variability, the variation in the climate pattern from year to year, is the "real bugbear" of Alberta weather, says Geitz.

"From year to year we get large variations in these critical climate variables. But agriculture as a business gears up for a normal year and the trouble is we never, really have a normal year."

This variability is particulary severe in northern Alberta. In the south, farmers can generally count on more than 120 frost-free days but in the north, frost-free days may vary from 60 to 120 days and a one-month variation is reasonably normal.

But although no one can yet control the weather and eliminate the climatic variables, steps can be taken to mitigate its effects.

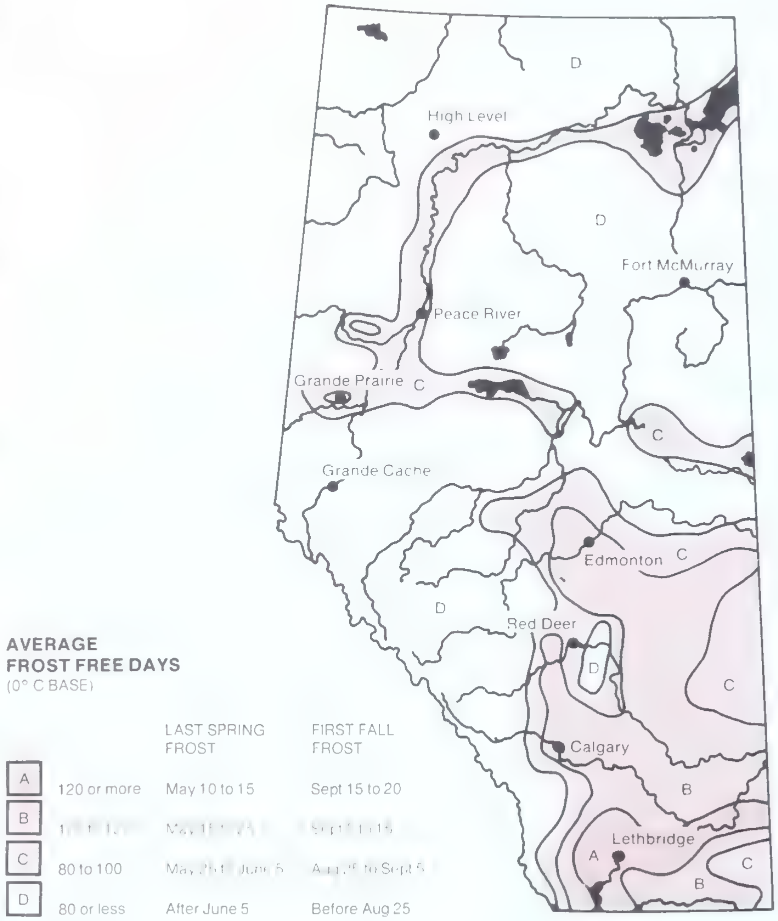
Chief among these are changes and improvements in land management practices. For instance, a number of agricultural practices have been used since the Dirty Thirties to mitigate the effects of drought. One of these is a change in methods of cultivation. Generally speaking, farmers are now more careful about the times of year that they till the land, the depth to which they till it and the machinery which they use. Overtilling the land makes it dry out and leaves it susceptible to wind erosion. New techniques are aimed at conserving existing moisture.

"We tell farmers to watch the depth they cultivate," says Jim Helm, head of Alberta Agriculture's research department. "We don't

Conrad Geitz

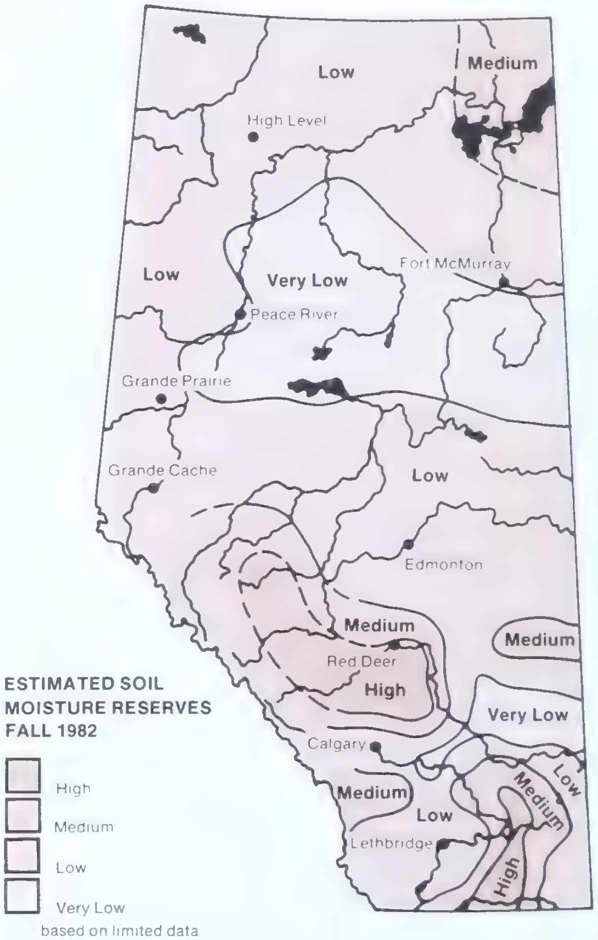
Helen Lui

Peter Mills



AVERAGE FROST FREE DAYS
(0° C BASE)

		LAST SPRING FROST	FIRST FALL FROST
A	120 or more	May 10 to 15	Sept 15 to 20
B	100 to 120	May 15 to 25	Sept 5 to 15
C	80 to 100	May 25 to June 5	Aug 25 to Sept 5
D	80 or less	After June 5	Before Aug 25



ESTIMATED SOIL MOISTURE RESERVES FALL 1982

- High
- Medium
- Low
- Very Low

based on limited data

like to see them cultivate more than three inches in the spring. We want them to leave the soil black, not dry and powdery so it blows away. We tell them if they want to plow deep, do it in the fall."

Helm also says the use of disc cultivators has improved tilling procedures. In addition, the use of herbicides instead of tilling to control weeds helps moisture as does strip cropping, leaving a trash cover on the fields and in some areas, summer fallowing.

Helm also recommends farmers in drier areas don't seed as heavily. Dense seeding, he says, takes away a plant's ability to adapt to dry weather conditions.

A second method of mitigating the effects of weather is to breed plants that fit the prevailing climatic conditions. Noteworthy examples are the development of field crops with increasingly short maturation periods.

For example, giant steps have been made in breeding wheat which is resistant to the wheat stem sawfly. This pest wrecked havoc on the once-prevalent hollow stemmed Marquis wheat, the grain that virtually opened up the Canadian prairies. Development of solid stem varieties has lessened danger from this pest.

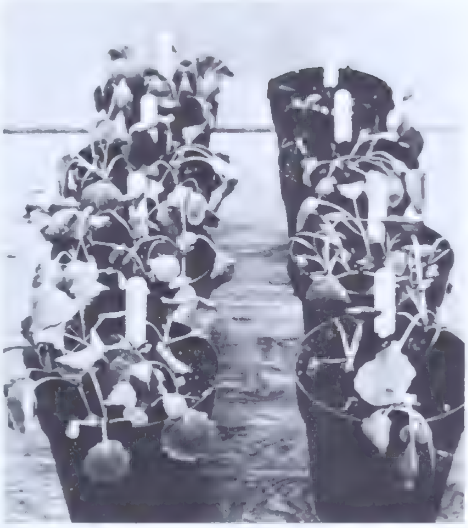
Scientists are also working on developing strains of various grains, notably wheat, that can survive with less water. They breed for drought-resistant qualities such as extensive root systems and leaves that are resistant to dessication.

One of the most significant advances for Alberta agriculture has been the development of a wide variety of grains with much shorter growing seasons the 100 to 110 days required for such old-time varieties as Marquis wheat. These early varieties have provided impetus for the continuing northward movement of agriculture in the province.

Peter Mills feels that any belief that agri-

Page 20 Barley plots at Trochu, Alberta, showing maturity differences and to some extent different response to drought stress. The darker plots would be later maturing and possibly more drought resistant since, when this picture was taken, lack of moisture was the most limiting factor to plant growth

Electron micrograph showing a common ice-nucleating bacterium (below).
The arrow points to ice-nucleating bacteria at the core of an ice crystal



Canola seedlings after five hours at subzero temperatures. Plants on the left were grown from seeds soaked in a suspension of non-nucleating bacteria (which compete successfully against nucleating bacteria). The other plants were grown from untreated seed.

culture in northern Alberta can't be successful is simply prejudice or lack of knowledge on the part of southerners.

"If crops take 120 days to mature, then sure, you're going to write off the Peace River agriculture. But we've got crops here that mature in 85 days and we get between 90 and 120 frost-free days here," says Mills enthusiastically.

But scientists aren't performing their only agricultural miracles in the breeding labs. They've also developed a sophisticated system of early warning devices to help make farming less of a gamble.

Conrad Geitz talks of a program for forecasting wind peak periods.

"The typical pattern for wind peaks is one in the fall and a second in the spring which is, of course, when farmers have to be out working their fields. But we can tell the farmer when a wind peak is coming and make sure he leaves his soil at its least-erodable during that period."

Entomologists and parasitologists also use sophisticated early warning systems to help farmers deal with insect pests. By watching the weather closely, entomologists like Helen Liu will know when an insect is in a critical stage of its development and consequently know the best time to use insecticides.

"For example, with the Bertha Army Worm, we chart the weather and we know when is the best time to deal with it. So we get on the radio and tell farmers to expect a heavy year for the worms but to go out and spray their crops on such and such a week," says Liu.

And the arsenal of science is putting even more weapons in the hands of farmers in the ongoing battle to offset and control the effects of weather. Alberta is a leader in the research involved in moderating and predicting hail. Work is also being done on snow pack advancement. Scientists are researching ambitious plans to seed clouds and encourage snowfall on the eastern slopes to increase the supply of water to river systems used for irrigation.

Some of the scientific advances are so fantastic they sound like pure science fiction. For example there is a project underway at the Agriculture Canada Research Station in Swift Current in which scientists use an infrared thermometer to take the temperature of plants. The lower the temperature the less evaporation of moisture. Using this data, scientist hope to be able to tell which plants are using moisture most efficiently.

Once that's done, breeders can breed for the genetic patterns of plants making the most of available moisture.

But perhaps one of the most fantastic

With a disc cultivator, soil can be cultivated shallowly, for minimum wind erosion and loss of soil moisture projects underway is one being carried out by Gietz which would ultimately use certain kinds of bacteria to make crops more frost resistant. The key to the program is the discovery that certain kinds of bacteria act as nuclei for the formation of frost crystals while others don't. Without these nuclei to precipitate the formation of frost, Geitz says plants could withstand temperatures well below zero degrees Celsius before they started to freeze.

"Everybody thinks that the freezing point of water is 32 degrees Fahrenheit or zero degrees Celsius. But they've proven that pure water can be taken well below that temperature before it freezes. It is these nucleating bacteria that allow an ice crystal to form and after that initiation, freezing becomes general and the plant is damaged."

The key, then, is to make sure that the only bacteria that are allowed to form on the plant are the kind that do not act as nuclei for frost. Antibiotics could be used to to kill the nucleating bacteria but this could cause environmental damage and perhaps damage to the plant. Geitz is experimenting with encouraging the growth of non-nucleating bacteria so they crowd out the unwanted variety. In the lab, Greitz has cooled plants to minus four degrees Celsius and even lower without damage once they have been treated to remove the nucleating bacteria.

"What we've done is changed our conception of frost. It's possible now to think of it as a bacterial disease," says Geitz.

The agrometeorologist believes his methods may be ready for use by farmers "in a few years and that's about as definite as I can get".

With these scientific advances in mind, it seems only a matter of time until scientists will actually be able to control and modify the weather itself, to decide when it will rain and when it will be dry, when the weather will be hot and when it will be cool. But until that time comes, farmers in Alberta and throughout the world will continue to watch the sky and plan as well as they can.

Norma Ramage is a Calgary journalism instructor and freelance writer

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Norma Ramage

Drought

"Our pigs are dying on their feet
Because they have no feed to eat,
Our hens are old and lay no eggs
Our turkeys eat grasshopper legs,
And Gabriel blows his trumpet sound
He says the rain she's gone around."

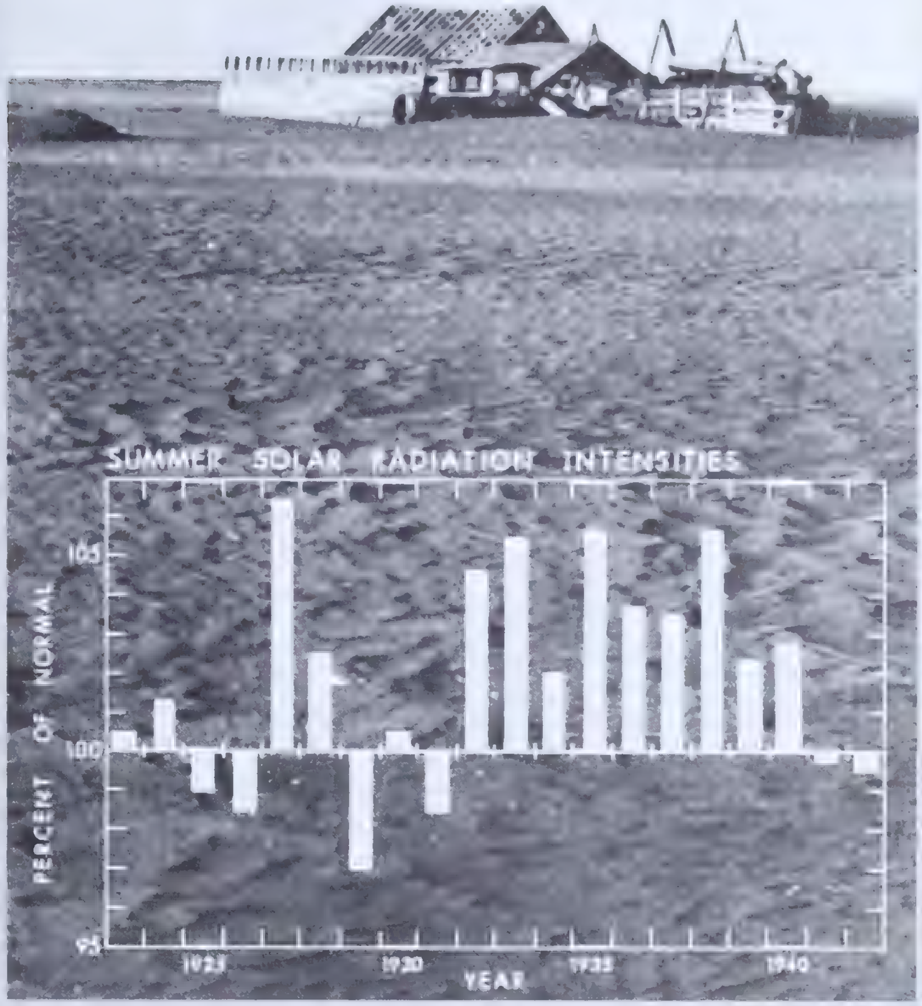
Depression Song

Drought. The very word is ominous. And when the reality strikes, the effects are shattering.

The great prairie drought of the 1930s turned more than 7.3 million hectares into semi-desert and drove 250,000 people from their homes. Farmers knelt in their fields and put shotguns to their heads as they watched their topsoil blowing away. The effect on wildlife was devastating and the economic and social implications for a generation catastrophic.

Yet despite its incredible impact and despite the fact that, according to a report by Bruce Findlay of the Environment Canada's Atmospheric Environment Service that "in terms of economic and social disruptions caused by weather, drought in western Canada is the most important", we know very little about this climatic phenomenon.

We've known for years that Alberta and much of the Great Central Plains of North America are prone to drought ever since 1857 when Captain John Palliser described the southern prairies as "a more or less arid desert" and flatly declared the area enclosed by the now-famous Palliser



As this chart shows, from 1932 to 1940, the prairies received much more solar radiation than normal.

Triangle to be totally unsuited for agriculture.

Despite Palliser's warnings, homesteaders moved in by the thousands, only to be driven away again during the Dirty Thirties. Those who remained have experienced recurring droughts in 1961, 1968, 1971, 1977 and 1979-80.

Droughts have been a part of Alberta's past and present and will no doubt be important in the future, but do climatologists and meteorologists know why, in the words of the song, "the rain, she's gone around"?

"No, we don't know what happened climatically to cause the Dirty Thirties," says agrometeorologist Conrad Geitz.

"We just know that from time to time due to interannual variability, we get a few years of drought. We know that the prevailing circulation systems changed and the storm tracks which carry the moisture shifted so the systems passed over a different area. But we don't know why that happened.

Geitz also says it is virtually impossible to predict when a drought will strike again.

"We're getting to the point where we can predict long term temperature changes with some reliability. But that's hard enough to do. It's almost impossible to predict precipitation changes."

But some researchers disagree with Geitz and the prevailing body of scientific thought.

"For those of us who are charged with doing something about drought, it's not good enough anymore to say drought is simply a random phenomenon," says Walter Nemanishen, a planning engineer with the Prairie Farm Rehabilitation Association (PFRA).

"We have to have some method of looking ahead, some sort of predictive equation."

Nemanishen says a group of scientists is working on identifying some of the "wild cards" which may cause drought, and he believes they may be on the point of identifying several causes of the phenomenon.

He points out that during the Thirties there were several successive years of intense solar radiation due to an exceptionally transparent atmosphere.

He also believes the location of the fronts that control Alberta's weather can provide a clue. When the ocean temperature warms, these fronts form further to the north than usual, changing the angle of the prevailing wind current. Instead of sweeping in on an angle that takes them over the northern United States and then out over the south-central portion of the prairies, they come straight in at the latitude of Prince Rupert and dump most of their moisture in the northern part of the three prairie provinces.

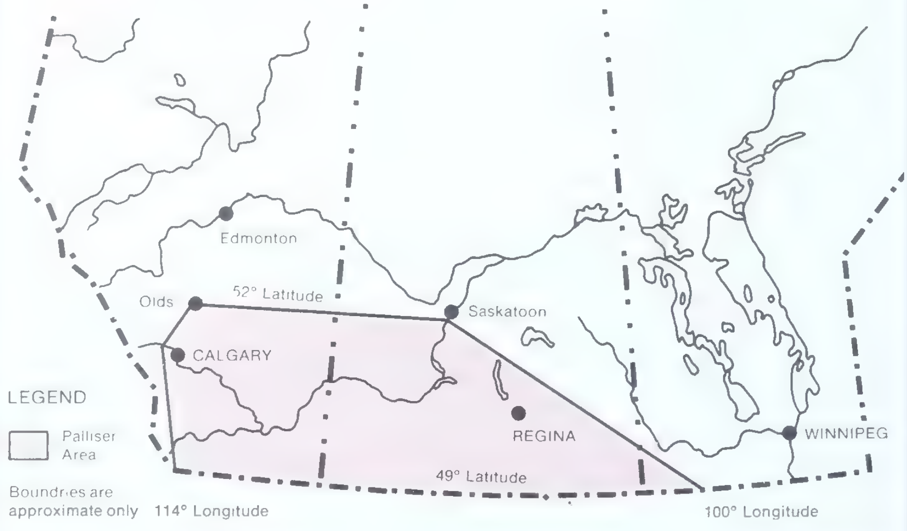
"In the '30s there were tremendous floods in the Slave Lake area when we had no rain at all down here. The drier and hotter it is down here, the more rain they get up there. For example, we had a hot, dry summer in 1971 and there were floods and heavy rains in the northern part of the province that year," says Nemanishen.

He feels something similar happened in Alberta this winter. The jet stream is coming across further north and the result was a mild winter with little snow for southern Alberta.

He also points to other wild cards, most notably the effect of dust veils, caused most often by volcanic activity.

U.S. studies show that in 1816, the year the Tambora volcano in Indonesia

THE DROUGHT-PRONE PALLISER TRIANGLE



erupted, there were extensive crop failures in the United States due to a noticeable cooling trend. In 1883 when Krakatoa erupted, ships' logs of captains piloting riverboats on the North Saskatchewan spoke of abnormally cool weather and late spring runoff.

"In fact," Nemanishen says, "I think it might be these dust veils that finally brought an end to the Dirty Thirties." "We threw up so much dust into the atmosphere that it blocked the radiation, cooled the atmosphere and brought the winds back to the south."

While several prominent scientists and climatologists such as Jerome Namias of the Scripps Institute of Oceanography in San Diego and the late Professor R.E. Longley of the University of Calgary have made progress in the prediction of drought, Nemanishen says that most experts are a long way from accepting that drought is anything other than a random climatic phenomenon.

But we have to start monitoring these wild cards," he argues. "We're sort of like Columbus. He thought the world was round but he also thought he could get to India by travelling west and then he bumped into North America. We believe there is a cause and effect relationship for drought and we're sailing off to find it but we might bump into something out there we don't expect."

But if experts disagree on the predictability of drought, they do agree on the immediate causes.

"Basically, drought is a shortage of water that results either from a shortage of supply, an excessive demand or a combination of the two," says Geitz.

In a drought year, there will be a lot of sunny days and little precipitation. Combine this with the fact that the warm and dry air masses that cause these sunny days also increase evapotransportation from the plants and the fatal drought cycle is established. If this condition persists from year to year, the drought becomes self-feeding.

"The key climatic factor is growing season precipitation, but if this is compounded by a dry fall the year before giving low soil reserve, the problem is aggravated," explains Geitz.

But drought is a complicated matter that involves more than a lack of moisture. Poor farming practices are also a contributing factor. And a dry year will encourage insect pests that prey on both crops and animals.

It is because many of these additional factors have been conquered that experts feel there will be no repetition of the enormous economic and social dislocation of the '30s.

"Similar climatic conditions today would work a hardship," says Geitz. "But farm management practices have improved so much that I don't think we'll see another period like the Thirties."

The PFRA, which was established specifically to prevent another Dirty Thirties has been in the forefront of helping farmers improve land management practices, says Erminio Caligiari of the PFRA's Calgary branch.

Chief among these are methods to help preserve available moisture. These include strip cropping, the controversial use of summer fallow and using herbicides rather than tilling to control weeds.

Farmers have also been taught to use methods that will make their land less likely to blow away in high winds. These include leaving a trash cover on the surface, planting cover crops and tilling the soil less deeply to prevent it becoming powdery and susceptible to blowing.

Organizations like the PFRA have also planted shelter belts of trees across the droughtprone areas of the prairies to help prevent wind erosion

Huge irrigation projects in places like southern Alberta and south-central Saskatchewan have also channelled new supplies of water to traditionally drought-ravaged areas.

One of the newest and most intriguing methods of battling drought is the breeding of drought-resistant strains of grain. Scientists like Dr. Ron De Pauw of Agriculture Canada research station in Swift Current are working on breeding drought-resistant genetic characteristics into grain.

"We breed for such things as more extensive root systems, for leaves with a high ability to tolerate dessication and for waxiness of the leaves and head, which could slow evaporation," he says.

Despite all these advances, there's still a danger that complacency might set in among today's farmers who haven't experienced the ravages of the' 30s.

"Unless you've watched two or three inches of your topsoil blowing away, it's easy to get a bit complacent," says Larry Welsh of Alberta Agriculture in Airdrie.

"I think most farmers practice good management but we always see some problems," says Welsh, mentioning a case that occurred just north of Calgary about three years ago. In that instance, a farmer was making too-extensive use of summer fallowing and the soil blew so badly onto a nearby highway that it obscured motorists' vision and caused a six-car pileup.

"In southern Alberta, within the last five or six years, we've had cases of wind blowing crops right away and blowing away the soil right down to the hardpan," says Welsh.

"The problem hasn't gone away."

Paul Tisdall

Alberta's New Lightning Detection System

Fires ignited by lightning account for more than 80 per cent of forest fire damage. To fight these fires, Alberta has acquired the most sophisticated lightning detection system in the world.

Alberta Research Council

In Alberta forestry circles it's become as famous as Black Thursday — a kind of forester's equivalent of the Saint Valentine's Day Massacre.

In a six-hour period on Thursday, August 27, 1981, a record-breaking 404,000 hectares (one million acres) of prime Alberta timber went up in smoke.

Not only was Black Thursday the worst day in the history of Alberta forest fires, but it came smack in the middle of the worst season.

During 1981, a record $56 million was spent by the Alberta Forest Service fighting the fires. By the end of the April to October season, a total of 1.3 million hectares of timberland had been consumed — also a record and some 30 times the annual average during the 1970s.

But 1981 wasn't the end of it. While last year's 750,000 hectares burned place it a distant second to 1981, 1982 did manage to establish a new record of $64 million spent fighting the fires.

The blame for this devastation can be assigned largely to one simple weather phenomenon — lightning.

Canadian Forestry Service statistics indicate that over 80 per cent of the forest fire damage in this country can be accounted for by lightning-caused fires. In fact, Alberta Forest Service statistician Bob Miyagawa estimates that for the past two seasons in Alberta the figure would be closer to 90 per cent.

Black Thursday is a case in point. According to Alberta Forest Service meteorologist Nick Nimchuk, the Black Thursday fires were started by a series of lightning storms between August 10 and August 13, 1981. After that, a blocking high aloft kept weather conditions warm, dry and windy until by August 27 "a real hell" had been created. As a result, fires raging out of control consumed large portions of the Footner Forest near High Level and of the Athabasca Forest in the Fort McMurray area. All fire fighters could do was wait for weather conditions to change and put the fires out.

The major problem during 1982 was similarly caused by lightning, Nimchuk says. A single storm system on June 13 ignited fires which burned over 400,000 hectares within a week.

With the devastation of lightning-caused fires in mind, the Alberta Forest Service is currently installing the most technically sophisticated lightning detection system in the world. The system blankets the entire province and will be fully operational for the first time this summer.

Alberta's $600,000 lightning detection set-up is a marvel of space age microelectronics. The equipment was orginally deve-

Bill McKeown

loped by Lightning Location and Protection Inc. of Tucson, Arizona, for the U.S. space program.

According to the company's science application, manager, Mike Maier, the space program's large metal service towers and the rockets themselves are frequently struck by lightning. Workers on the towers have been injured and disaster was narrowly averted when Apollo 12 was damaged by two lightning strikes shortly after take-off. Of particular concern is the harm lightning-induced currents could cause to sensitive electronic equipment on the shuttle. So space shots are now routinely postponed if the new equipment detects a lightning storm near the launch site.

Mike Maier credits Canadian foresters like AFS head of planning Joe Niederleitner with being the first to recognize the system's potential value in fighting forest fires. Encouraged by Canadian foresters, the company developed a system tailored to their requirements.

The basis of the Alberta system is the seven direction finders scattered throughout the province and capable of detecting lightning anywhere within provincial boundaries. The direction finders operate on a relatively simple principle. Everyone is familiar with the havoc electrical storms can play with home radio reception. The same lightning-produced radio waves that cause static on home radios are used by antennae on direction finders to detect lightning.

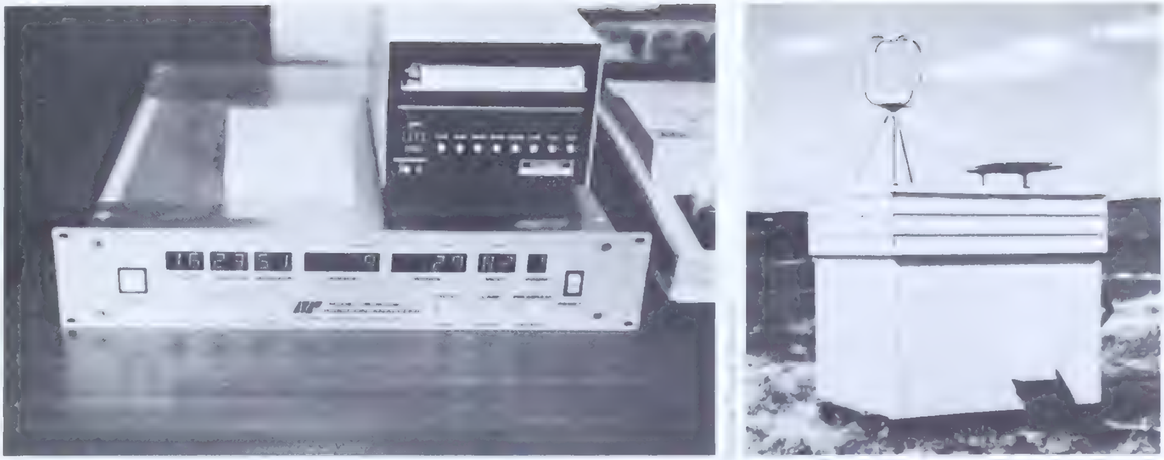
Once they are detected, signals from the seven direction finders are relayed via phone lines to the central computer of the position analyzer in Edmonton. The system is dense enough so that any particular lightning flash will be detected by more than one direction finder. By combining information from the direction finders, the computer is able to determine the strength of the flash and, by triangulation, to pinpoint its location.

Of course, only lightning which actually strikes the ground can start a forest fire. Lightning Location and Protection research has determined that cloud-to-ground lightning produces a unique radio wave pattern distinct, for example, from cloud-to-cloud lightning. So the equipment rejects anything but cloud-to-ground strikes.

Information about the strength and position of lightning strikes is displayed on color-coded maps of Alberta on a television monitor at AFS's Edmonton headquarters. Hard copy colour prints can also be made.

Once the position analyzer has processed the data, it is sent out via land lines to remote display processors in the ten field headquarters located in each of the province's main forests. Here, as well, information about lightning strikes is available on colour television monitors or in hard copy. In fact, fire fighters can choose from a range of 99 maps which cover anything from the whole province to a small forest zone within their own area.

While it's still too early for a reliable assessment of the system's effectiveness, Lightning Location and Protection believes that it will be worth five to ten times its original cost in terms of forest saved.



Lightning detection equipment a lightning direction finder in the field (right) and the computer which plots the position of lightning strikes (left)

AFS head of planning Joe Niederleitner is a staunch believer. As an example of the potential value of the system, he cites the August 1981 fire which threatened Swan Hills, forced the evacuation of its 2,500 residents and cost the province $5 million to fight. The Swan Hills fire, it was later discovered, was ignited by a brief, ten-minute lightning storm the day before. But, at the time, the lookout tower failed to spot it.

"We feel that if we'd had our equipment in place, we would have known there was a lightning strike," Niederleitner says. "We would have checked the area and perhaps put the fire out while it was still smouldering."

The new lightning location equipment is also paying unexpected dividends with new knowledge about a previously mysterious type of lightning known as "positive lightning". In fact, Gene Kitar, head of the Northwest Territories lightning location program, believes that postitive lightning may be the principal cause of forest fires.

Normal or negative lightning is what we commonly experience during a thunder storm. It is accompanied by storm clouds, rain and wind, and apparently comes right out of the cloud to strike the ground below.

Normal lightning begins when a region of negative charge builds up near the bottom of a storm cloud. A preliminary low-current discharge traces a conducting channel to the ground. A large surge of current, the return stroke, immediately follows. In a typical lightning flash, this process is repeated 3 or 4 times and the whole flash takes only a fraction of a second.

While negative charges are building and discharging in the bottom of the storm cloud, the top of the cloud gathers an enoumous excess of positive charge. Eventually, the cloud virtually blows its top. An electrical charge travels from ground to cloud creating positive lightning.

Positive lightning can strike the ground as far as 30 km. away from a storm cloud. When it does, it can come without warning out of a clear blue sky and strike with three times the current and twice the duration of normal, negative lightning.

Joe Niederleider

In the past, stories of a catastrophic bolt out of the blue demolishing a house or a car have been dismissed as nonsense. They may, in fact, be instances of positive lightning.

Prior to the development of lightning detection equipment, little was known about positive lightning. It was thought to be an extremely rare phenomenon and some scientists even doubted its existence.

But the new equipment is able to distinguish positive from negative flashes. Rather than extremely rare, it has been discovered that positive lightning is actually relatively common, particularly in northern latitudes. In Alberta, for instance, as much as 20 per cent of the lightning is positive.

For fire fighters, the ability to detect positive lightning may be extremely important. "Positive lightning," says the Northwest Territories' Gene Kitnar, "may actually be starting most of the forest fires. Because it hits a dry area, and because it's of longer duration and higher current, we feel it is far more likely to cause ignition of the fuels."

Another new wrinkle in the lightning location equipment is currently under development at Lightning Location and Protection's Tucson headquarters. This is a numerical computer model which will combine data about weather and fuel conditions with the lightning information in order to issue a prediction about the most dangerous fire situations.

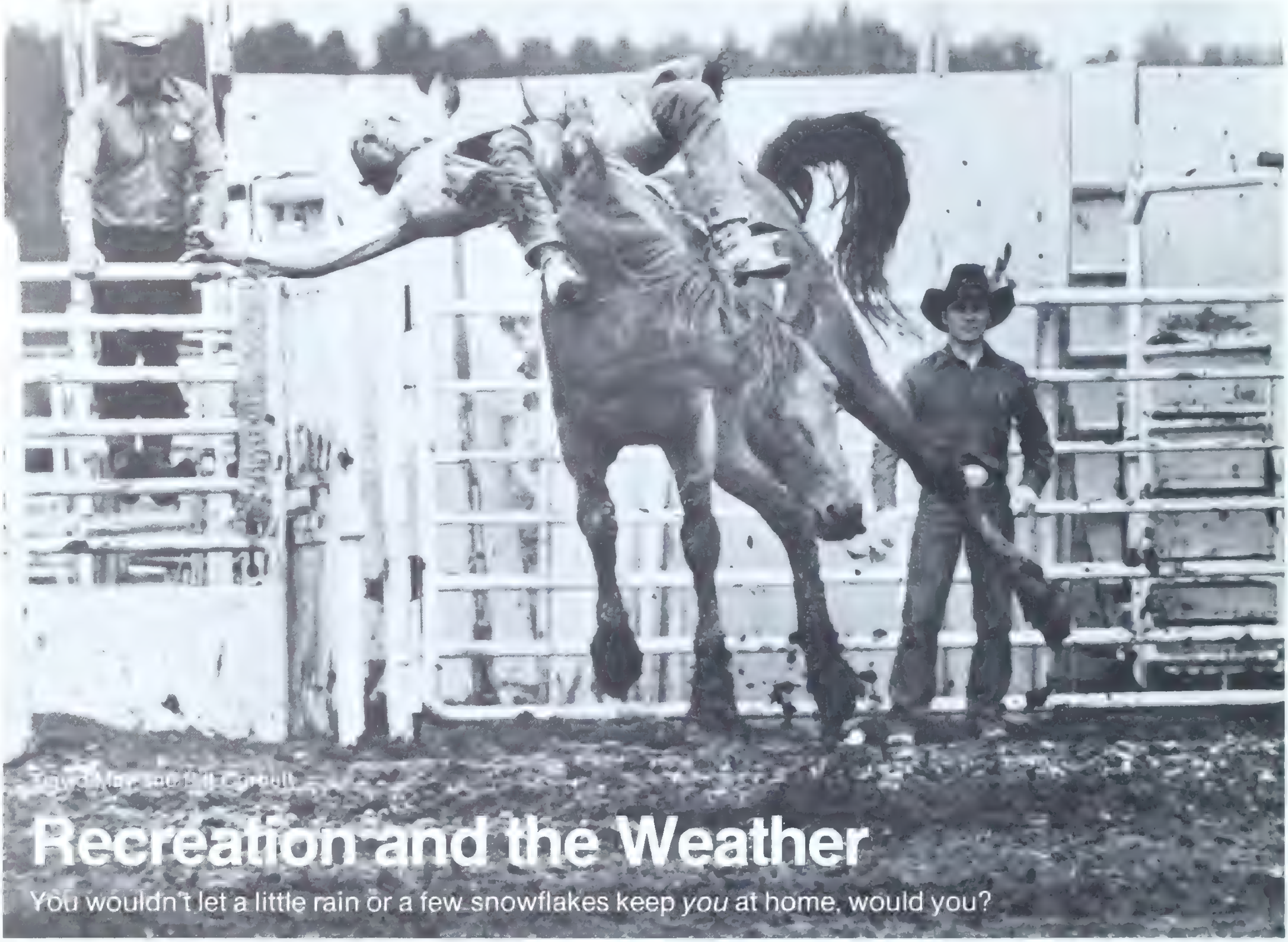
If the new lightning location system performs as promised, it will enable fire fighters to pinpoint the most threatening lightning flashes and to dispatch crews to snuff out the fires while they are still relatively small. In doing this, it could make a significant contribution to the solution of the most pressing problem fire fighters currently face — escalating costs.

Once a fire rages out of control, fighting it becomes an enormously expensive proposition. At one point during the 1981 inferno, the Alberta Forest Service had 150 helicopters chartered — some costing as much as $1,800 an hour. For the 1982-83 fiscal year, Alberta's Forest Protection Branch budgeted a seemingly adequate $21.1 million. But because of the devastating fires last summer, expenditures will now total more than four times as much, a whopping $88.5 million.

For the first time, the Alberta Forest Service is being forced to consider "priorizing" fires as a cost-cutting measure. According to Howard Gray, head of AFS fire operations, fewer resources will be dedicated to fighting fires which threaten low priority land and which escape initial attack.

Certainly we're still a long way from allowing millions of hectares to burn because we can't afford to fight the fires . If the new lightning location system works as planned, it could help us avoid this prospect altogether.

Paul Tisdall a former journalist, is an Edmonton freelance writer who specializes in science writing



[illegible] and Bill Corbett

Recreation and the Weather

You wouldn't let a little rain or a few snowflakes keep *you* at home, would you?

Sue Lawrence and the House Moutain Cultural Improvement Society worked hard to organize Whitecourt's 1982 Winter Carnival. There was a snowmobile hill climb, three-legged snowshoe races, a tug-of-war, ice sculpture competition, a Best Dressed Voyageur event and even a tea-making contest — contestants had to build fires and melt snow for their cups of brew.

Despite the organizers' ingenuity, cold and wind kept all but 60 of Whitecourt's 4,400 people at home.

Like the high winds that blew away Whitecourt's winter carnival, weather can wreak havoc with recreation, but it can also set the seal on a perfect event.

In St. Albert, rain falls so consistently on the Kinsmen's annual June rodeo that in 1974, after a decade of uninterrupted drenching, it was re-named the Rainmaker Rodeo. In fact, St. Albert gardeners traditionally spread their fertilizer a few days before the event, confident that the rain will soon wash it into the soil.

In Wetaskiwin, organizers of the North-Am International Snowmobile Race refuse to even think of snow as February nears.

"What we want is ice," says Gene Daniel, 1983 North-Am chairman. In 1981, Wetaskiwin got lots of snow. "It took us a week to plow the track," says an unamused Daniel.

Before a major event, competitive snowmobilers dream of cold temperatures and low blizzard hazards. For 14 years now the Wetaskiwin event has been held in the second or third week of February when, statistically, the chance of ideal weather is the highest.

Wetaskiwinites are farmers, so they know from experience when to expect low precipitation and cool weather. But Environment Canada has a Probability of Precipitation Chart, just in case the farmer — or the snowmobiler — wants to confirm his hunches.

The PPC plots how often it has snowed, rained or hailed each day of the year, over a 30-year period. So it is a very handy tool for those planning major recreation events like games in outdoor arenas, rock concerts or large-scale picnics.

But it's not infallible, as the sunny story of the 1978 Commonwealth Games happily demonstrated.

According to the PPC, the odds in favor of precipitation for the days chosen to stage the games —August 3 to 12— were more than 40 per cent.

Defying this rather dire prediction, the games were played in temperatures consistently above normal, above 30 on two days and never dipping below 19 degrees.

And the rain which statistically ought to have occurred? Except for a light shower August 5, not a drop until the closing day.

"Had the games fallen a week or two later," says Enviroment Canada meteorologist Will Prusak, "it could have been quite a different story." (Four days after the athletes had returned home, a downpour dumped more rain in one day than the city had seen all the rest of August. By month's end, the rainfall total was almost 30 per cent higher than average.)

The Calgary Stampede is often blessed with clear skies, but Stampede historian Tom Hall vividly remembers 1950, the year of the deluge. That year marked the end of free entry onto the grounds for Indians not taking part in the show. Participating Stoney Indians, through a misunderstanding, thought the new rule included them and boycotted the Stampede.

"They claim to have performed a rain dance," Hall said. "Whether or not they did, it rained and rained. It was a disaster."

The definition of bad weather varies with the sport. A fly fisherman curses rain. A

A muddy ride at St. Albert's Rainmaker Rodeo (left).

Calgary Herald

goose hunter laments blue skies.

For seven years, Jim McLennan has been running guided float trips for fly fisherman on the Bow River downstream of Calgary. The Bow has a world-renowned trout fishery, thanks to the dumping by the city of nitrogen and phosphates that creat a thriving environment for insects and plant life. But when a rainstorm sweeps the city, muddy sewer water is washed into the river.

"If the water is muddy, there's no point in fishing because you can't fish on flies in muddy water," McLennan said. "If that happens, we refund the money or change dates."

Every year, two or three trips are cancelled, at a cost of $180 per person per day.

Each fall the small town of Hanna in eastern Alberta attracts hundreds of hunters from across Canada and the United States in search of geese. The worse the weather, the more birds fly and feed and the better the hunting is.

"A goose hunter is a pretty avid person," said Bob Currie, owner of Big Country Sports and Cycle in Hanna. "If someone is coming from Florida, they're not worried about the weather."

Allan Derbyshire is another who doesn't anxiously check the forecast each morning. Derbyshire's Lac Des Arcs Climbing School offers outdoor courses ranging from kayaking to cross-country touring.

"We never cancel," he said. "People who register for our courses are aware that when they take up outdoor pursuits, they must put up with the weather."

Derbyshire will even take advantage of such hazards as avalanche slopes to show students how to recognize potential dangers.

For ski resort operators, success can be summed up in one word—snow. Snowfall must be both consistent and timely.

"We count every snowflake in nickels," says John Worrall, area manager of the Lake Louise ski resort. "We consider it to be the major factor."

The Rocky Mountains are generally unreliable for snow, says Tim Auger, the Banff warden in charge of the avalanche program at Sunshine Village. Consequently, ski operators engage in what Auger calls "snowfarming."

"Operators in the Canadian Rockies can make more of less snow," he says. "They try to nail down every snowflake that lands. They know how to groom their slopes."

Sunshine, located in the snow belt along the continental divide, receives on average the most snow of any Alberta resort. But even there, snow is carefully guarded. In most cases snow is trapped by fences and quickly collected and stored in reservoirs, ready to be returned to the slopes when the snow pack thins.

But at times, there is no snow to groom, particulary at the beginning of the ski season. If heavy snowfalls don't arrive until January, operators have lost crucial revenue from the Christmas holiday season. This past season was a disaster for Quebec and Ontario resorts, with most receiving more rain than snow over the holidays.

Nearly every North American resort being planned has snow-making equipment included in the blueprints. Laying water lines and pumping water uphill is expensive but in marginal snow areas, it's worthwhile.

Several ski operators say their biggest headache is bad weather in cities miles from the hill.

"The worst thing for us is a winter without snow on the prairies," says Gordon Russell, general manager of Westcastle Park, near Pincher Creek." We usually have enough snow, but if it isn't snowing in the cities, people don't ski. The diehards do, but a lot of intermediate skiers don't even think that there might be snow here.

At lower elevations, the chinook brings warm, dry winds that can melt a snow cover in hours. Earlier this winter in Calgary, for example, temperatures rose from minus 19 to plus 11 in half a day.

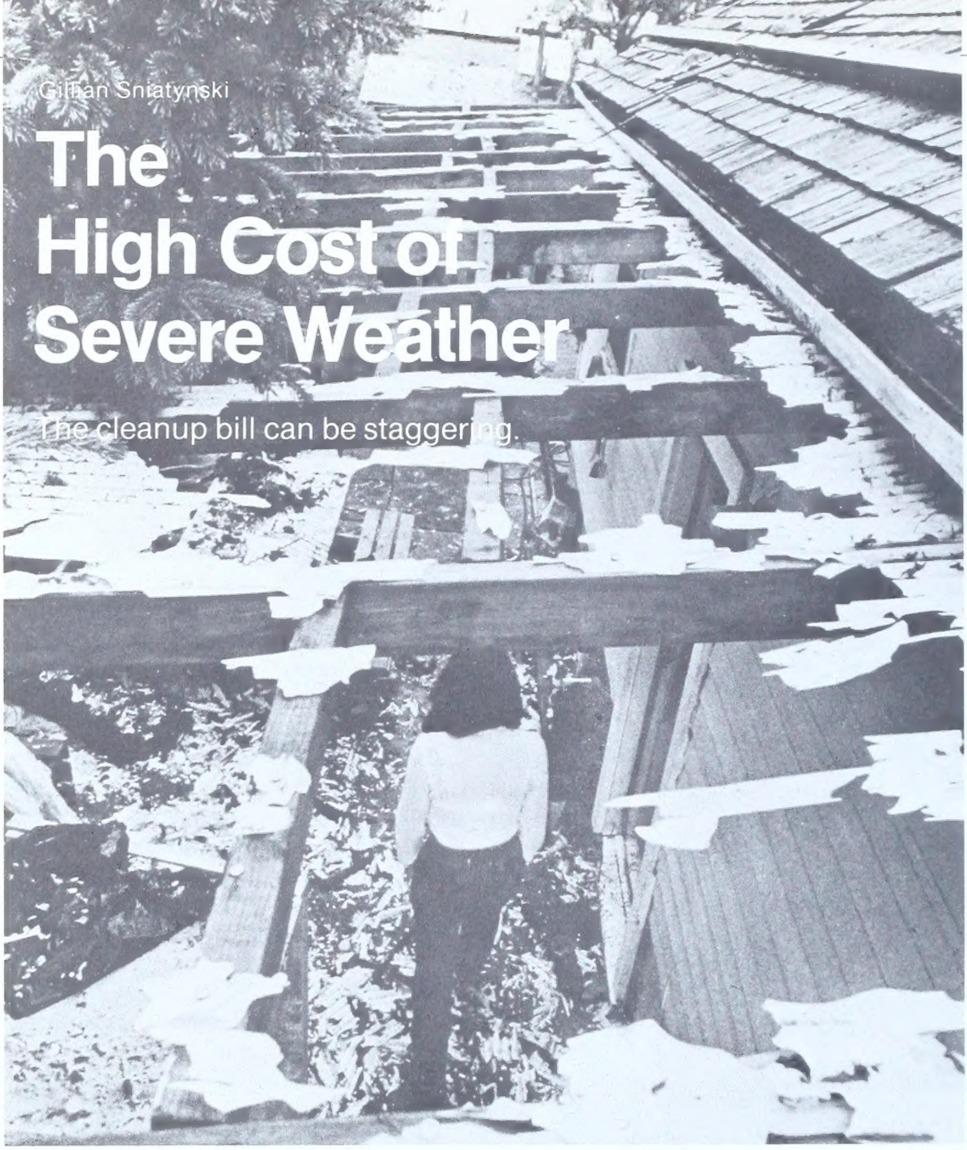
Chinooks are a major reason why many outdoor activities are restricted in Calgary during the winter. The possible lack of snow is a concern for organizers of the 1988 winter Olympics. Included in the Olympic budget are funds for snow-making equipment at the sites for downhill and cross-country skiing and ski jumping. In an emergency, the army would probably be used to truck snow in.

David May and Bill Corbett are both former journalists now working as freelance writers, in Edmonton and Calgary, respectively.

Gillian Sniatynski

The High Cost of Severe Weather

The cleanup bill can be staggering.



The aftermath of Calgary's multimillion-dollar hailstorm.

Calgary Herald

On July 28, 1981, at about 6 p.m., a hailstorm streaked through a residential section of Calgary.

It tore down power lines, destroyed gardens, dented vehicles, tore off roof shingles, broke glass in greenhouses — all in the space of about 20 minutes.

"It nearly missed the city," said Jim Sinclair, chairman of the emergency response plan committee of the Insurance Bureau of Canada in Calgary.

"I shudder to think what might have happened if it had come right downtown."

In the wake of the storm, insurance companies settled some 65,000 claims, fairly evenly split between auto and property damage. Payments totalled at least $150 million, but the exact figure isn't known. Says Sinclair: "It got so bad that we literally stopped counting."

The storm was a classic example of the sort of severe weather phenomenon occasionally visited on us. It was extremely local, lasted only a short time, and blew up through convection currents, seemingly out of nowhere. It became (at least in 1981 dollar terms) the most costly single weather disaster in Canadian history — graphic evidence (if any were still needed) that "severe" weather is severe at least partly because of its economic impact.

Farmers certainly don't need to be told that severe weather can cost plenty: hail storms that lay months of work to waste in the field are the scourge of prairie crop-producers.

Insurance tells that story too. The Alberta Hail and Crop Insurance Corporation paid at least $50 million to farmers as settlement for hail damage to crops last year — a "disaster year", according to the corporation's research director, Rod Rains. (The payment in 1981 was about $20 million, and in 1980 about $26.5 million).

Tornadoes are even less respectful of property than are hailstorms, but mercifully, their sphere of activity is small, and seldom in built-up areas.

Jim Sinclair notes that wind coverage is automatically included in most comprehensive insurance policies — and tornadoes in Alberta are classed, with nice understatement, as wind. That may be useful for their victims to know: though tornadoes cut a much smaller swath, the damage they cause can be devastating. Last summer 26 tornadoes were reported in Alberta. One at Dovercourt on June 30 injured one person and caused damage estimated at $500,000.

Urban dwellers probably fear hail and tornadoes less than severe rain. It's a fear with links to the pocket book because heavy rains can lead to floods, and with few exceptions, flood insurance isn't available. ("The problem is that the people in the river valley want it and the people on the mountain top don't," explains Sinclair. "There's no spread of risk, which is what insurance is all about.")

In the absence of insurance data, it's possible to get some idea of the financial cost of severe rainstorms by a study of payments made by Alberta Disaster Services.

This organization offers "financial assistance toward recovery from losses and damages resulting from an occurrence which those directly affected could neither prevent nor readily nor reasonably insure against."

For example, Alberta Disaster Services paid out $2,218,198 to the City of Edmonton and 1,536 individual residents for clean up and compensation after a severe rainstorm on July 11, 1978 lashed the city, leaving behind it a trail of flooded basements and in a few cases much more costly damage.

The Insurance Bureau of Canada's Sinclair feels it's important to remember, in any consideration of the economic impact of severe weather, that most of the available figures relate to physical damage. That, in some cases, may be the *least* of the damage. Insurance may cover the loss of a factory roof in a wind storm — but unless the owner has interruption-of-business coverage, there's no recompense for the three months his business is closed for repairs.

The Calgary hailstorm dented a lot of cars and broke a lot of windows. According to local media reports, it also drove a local flea market operator out of business: he had no insurance coverage to offset the $22,000 damage his business suffered. A florist business sustained $14,000 worth of glass damage to its greenhouses (more than 70 per cent of which were affected). The company was ininsured — it had felt insurance premiums were too high.

Gillian Sniatynski, the former editor of Environment Views, is an Edmonton freelance writer.

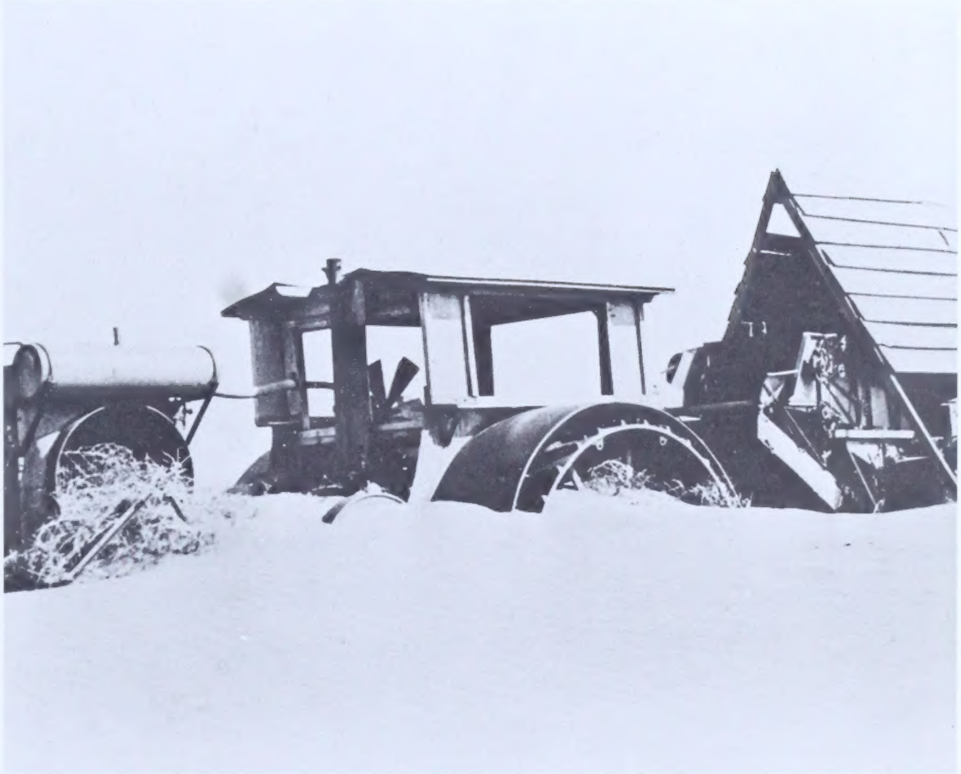
Using Environment Views in the classroom

The topic of the human side of weather and climate is an interesting one for students in both social studies and science classrooms. This issue of Environment Views covers such aspects of weather and climate as drought, lightning, effects on health, climatic change, carbon dioxide in the atmosphere and changing weather conditions. Combined with the previous issue (Environment Views, January/February, 1983) on weather and climate, teachers could deal with the topic from a number of points of view, including technical aspects of forecasting, scientific advances in controlling weather as well as the social and economic consequences of weather and climate (past, present and future).

Regardless of the subject area or topic the key issue becomes one taken directly from an article in this issue.

> "Man now can do something about the weather — and is able to influence the physical and biological conditions of this future."

The question then becomes "Should man use this ability?"



A threshing machine is nearly buried by drifting soil during the long prairie drought of the Thirties.

Glenbow Alberta Institute

Relationship to Curriculum

Social Studies

Issues in social studies on the human side of weather and climate can be incorporated at the grade 9, 10 and 11 level.

Science

Many aspects of the human side of weather and climate relate to specific areas of the high school Science curriculum, in Science 11, Chemistry and Biology. As well, the topic provides a number of interesting questions of a general scientific nature. Many of these aspects can be combined with the January/February, 1983, issue of Environment Views.

Specific topics include:

(a) What role can science provide in controlling weather and climate? Should science be involved in this type of control?
(b) How can lightning be detected quickly and accurately?
(c) What can be done to prevent severe drought returning to the prairies?
(d) What can science do to promote greater yields in agriculture
(e) How much damage does carbon dioxide do to the environment?

Social Studies 9, Topic C Industrialization in Canada

Many aspects of the introduction of new technology in Canada are associated with its effect in weather and climate.

To what extent should governments allow the introduction of new technology which may increase the amount of carbon dioxide in the air?

What effect does the introduction of new technologies in areas of weather and climatic changes have on Canadians?

Social Studies 10, Topic B Canadian Unity

A different approach to weather and climate could lead to an analysis of its effect on Canadian unity.

To what extent did the drought on the prairies during the 1930s contribute to western alienation?

Social Studies 20, Topic B, Global Problems of Population and Resource Distribution

Used in conjunction with the previous issue (January/February, 1983) the question of the effects of weather and climate changes on third world countries can be explored.

How would a climatic change effect third world countries in the areas of food production, population growth, resource development and economic power?

Editor's note: In the previous issue on weather and climate, a description of the movement of air masses on page 19 included the statement that "since cold air is denser than warm air, the cold air rises". Of course, this should have read, ". . . the warm air rises". We apologize for any confusion this slip may have caused.

If undelivered, return to:

Environment Views
Alberta Environment
9820 - 106 Street
Edmonton, Alberta T5K 2J6

Environment Update

Waste Management

The Oldman River Regional Planning Commission is holding its 24th Annual Workshop on March 23, in Lethbridge. This year's topic is "Dealing With Waste".

Keynote speakers, as well as panel and round table discussions, will focus on a variety of issues, including the impact of waste on the environment, fundamentals in dealing with waste, the regional landfill and alternative technologies to landfill.

For further details please contact Cheryl Wheeler at 329-1344 (Lethbridge). Pre-registration is necessary.

Eastern Slopes

The Canadian Society of Environmental Biologists is sponsoring a one-day symposium on Resource Management in the Eastern Slopes, to be held March 19 at Red Deer College. Fred McDougall, ENR deputy minister, renewable resources, will be speaking on government policy, and in the afternoon there will be a panel discussion of "Perspectives on Resource Integration in the Coal Branch".

For further information and registration call Allan Garbutt 434-1372.

Fish and Wildlife Resources and Economic Development

On April 26 and 27 in Edmonton, the Canadian Society of Wildlife Biologists will be sponsoring a symposium on issues relating to fish and wildlife resources and economic development. For further information contact Don Thompson 429-9110, or for an outline, write to: The Secretary, Alberta Society of Professional Biologists, P.O. Box 566, Edmonton T5J 2K8.

...and now for a first-hand look at today's topic...
"DEALING WITH WASTE"

Martha Jones

National Meeting of Environmental Groups

A meeting has been called of environment groups from across Canada to be held in Ottawa April 29 - May 3. The purpose is to continue the development and strengthening of Canada's environment network; and "to discuss and understand current development strategy and where it is leading us".

For information contact Brian Staszenski 424-3301

Environmental Biologists Meet

Monthly meetings of the Canadian Society of Environmental Biologists will be held at the Provincial Museum in Edmonton at 8 p.m. on March 14 and April 11.

For further information call John Lilley 427-5791 (Edmonton) or Mark Polet 233-3976 (Calgary).

Environment Week 1983

It has been announced that Environment Week '83 will be held June 5-11. The week of events and displays, presented by Environment Canada, the Environment Council of Alberta and Alberta Environment, is designed to focus public attention on environmental issues.

Homecoming at Banff

1983 is the 50th anniversary of the founding of the Banff Centre, and the centre is inviting all former students, faculty and staff to "come back to Banff" for its first "Homecoming Week" April 30 - May 8.

Our Mistake

Two errors occurred in the January/February issue: the photograph by Arjen Verkiak which appeared on page 17 was incorrectly attributed to Bill McKeown; diagrams and instructions for making weather instruments which appeared on pages 34 and 35 should have been credited to Environment Canada.

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.